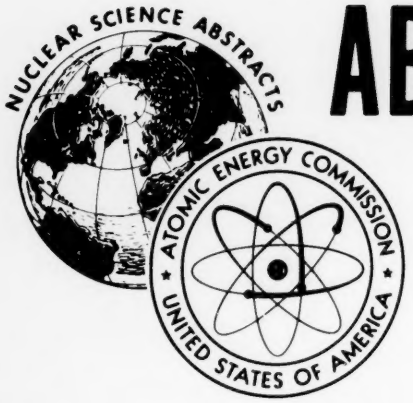
NUCLEAR SCIENCE ABSTRACTS



Volume 27 Number 3

Abstracts 4918-7333

February 15, 1973

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Volume 27, Number 3, February 15, 1973

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted:

NEWCOMB, William A., Stability of a magnetic well, 25:1239
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separation by ion exchange and complex-formation elution, 25:251(P)
TRIETHYLENETETRAMINE
complexes with cobalt(III) and rhodium(III) chlorides, radiation effects on labeled, thermal-neutron, 25:137
TRITIUM
content in Cattaraugus Creek near West Valley Processing Plant, July through Dec. 1969, 25:258 (DOCKET-50201-48)
content in Cattaraugus Creek near West Valley Processing Plant, Jan. to July 1970, 25:259 (DOCKET-50201-49)
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372 (UCRL-72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009-1). Dep. NTIS.

is indexed as:

CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
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Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 27, Number 3, February 15, 1973

Category	Page
CHEMISTRY	473
Analytical Chemistry	473
Activation and Nuclear Reaction Procedures	473
Chemical and Spectral Procedures	475
Radiometric and Radiochemical Procedures	478
Separation Procedures	479
Inorganic, Organic, and Physical Chemistry	480
Chemical and Physicochemical Properties	480
Isotope Effects	481
Isotope Exchange and Isotope Separation	483
Feed Materials Processing	484
Radiation Chemistry	485
Radiochemistry and Nuclear Chemistry	490
Hot-Atom Chemistry	490
Properties of Radioactive Materials	492
Radioactive Waste Treatment	494
Radioisotope Production	495
Reactor Fuel Reprocessing	495
ENGINEERING	496
Energy Conversion	496
Facilities and Equipment	496
Heat Transfer and Fluid Flow	497
Materials Testing	497
Nuclear Explosions	497
Protective Structures and Equipment	498
Safety Engineering	499
ENVIRONMENTAL AND EARTH SCIENCES	500
Minerals and Ores	500
Radioactive Effluents	500
Radioactivity Monitoring and Transport	500
Atmosphere	503
Soil	504
Water	504
Ecosystems and Food Cycles	506
Radiometric Techniques	509
Site Surveys	509
Thermal Effluents	509
INSTRUMENTATION	510
Radiation Detection Instruments	510
General Detectors and Monitors	510
Radiation Dosimeters	511
Nuclear Spectroscopic Instrumentation	512
High Energy Physics Instrumentation	514
Radiometric Instruments	515
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	516
Miscellaneous Instruments	516
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	519
Isotope Separation (Industrial)	519
Isotopic Power Sources	519
Radiation Sources	520
Design and Fabrication	520
Industrial Uses	520

Category	Page
LIFE SCIENCES	522
Radiation Effects on Biochemicals	522
Radiation Effects on Cells	522
Radiation Effects on Microorganisms	523
Radiation Effects on Plants	524
Radiation Effects on Animals	526
Man	526
Vertebrates	529
Invertebrates	533
Radionuclide Effects (Internal Source)	535
Man	535
Animals	535
Plants	535
Nuclide Kinetics and Toxicology	535
Man	535
Animals	535
Plants	536
Microorganisms	537
New Tracer Techniques	537
MATERIALS	539
Ceramics and Cermets	539
Metals and Alloys	541
Corrosion and Erosion	541
Preparation and Fabrication	543
Properties, Structure, and Phase Studies	544
Radiation Effects	549
Other Materials	551
NUCLEAR MATERIALS AND WASTE MANAGEMENT	553
Accountability and Safeguards	553
Disposal and Storage	554
Handling Equipment and Procedures	555
PARTICLE ACCELERATORS	556
Auxiliaries and Components	556
Ion Sources and Injection and Extraction Systems	556
Ion Optics and Field Calculations	557
Storage Rings	558
Experimental Facilities	559
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	561
Cosmic Radiation	561
Stars	561
Quasi-Stellar, Radio, and X-Ray Sources	564
Solar Phenomena	567
Galaxies	569
Cosmology	569
Planetary Phenomena	571
PHYSICS (ATMOSPHERIC)	572
Auroral and Ionospheric Phenomena	572
Magnetospheric Phenomena	573

TABLE OF CONTENTS (continued)

Category	Page
PHYSICS (ATOMIC AND MOLECULAR)	575
Beams and Their Reactions	575
Atomic and Molecular Properties	575
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	575
Collision Phenomena	575
Atomic Theory	579
PHYSICS (ELECTROFLUID AND MAGNETOFLUID)	581
PHYSICS (HIGH-ENERGY)	582
Particle Interactions and Properties (Experimental)	582
Electromagnetic	582
Weak	583
Strong (Baryon-induced)	584
Strong (Meson-induced)	585
Particle Interactions and Properties (Theoretical)	586
General	586
Electromagnetic	587
Weak	588
Strong (General)	589
Strong (Baryon No. = 0)	590
Strong (Baryon No. = 1)	590
Strong (Baryon No. ⩾ 2)	591
Particle Invariance Principles and Symmetries	592
General	592
Applications (Electromagnetic and Weak)	592
Applications (Strong)	592
Field Theories	592
General	592
Quantum Field Theory	592
Gravitation and General Relativity	593
Scattering Theory	594
PHYSICS (LOW-TEMPERATURE)	595
Superfluidity	595
Superconductivity	599
Equipment and Devices	610
PHYSICS (NUCLEAR)	612
Neutron Interactions with Matter	612
Nuclear Properties and Reactions, A ⩽ 5	613
Nuclear Properties and Reactions, 6 ⩽ A ⩽ 19	613
Nuclear Properties and Reactions, 20 ⩽ A ⩽ 38	616
Nuclear Properties and Reactions, 39 ⩽ A ⩽ 58	619
Nuclear Properties and Reactions, 59 ⩽ A ⩽ 89	620
Nuclear Properties and Reactions, 90 ⩽ A ⩽ 149	622
Nuclear Properties and Reactions, 150 ⩽ A ⩽ 189	623
Nuclear Properties and Reactions, 190 ⩽ A ⩽ 219	624
Nuclear Properties and Reactions, A ⩾ 220	625
Nuclear Theory	626
PHYSICS (PLASMA AND THERMONUCLEAR)	633
Confinement and Heating	633
Diagnostics	634
Kinetics (General)	635
Kinetics (Experimental)	637
Kinetics (Theoretical)	638
Production	639
Stability	639
Thermonuclear Processes	642
Wave Phenomena	643

Category	Page
PHYSICS (RADIATION AND SHIELDING)	646
Radiation Physics	646
Radiation Source Calibration and Standardization	647
Shielding Calculations and Experiments	647
PHYSICS (SOLID-STATE)	648
Radiation Effects	648
Physical Properties	651
Moessbauer Effect and NMR	654
Theory	655
PHYSICS (THEORETICAL)	656
REACTOR TECHNOLOGY	658
Power Reactor Development	658
Physics and Core Engineering	658
Control Elements, Systems, and Instrumentation	659
Cooling Systems	659
Fuel Systems and Components	661
Auxiliary Systems, Protection Systems, and Engineered Safeguards	662
Operation and Economics	662
Safety and Siting	662
Commercial Power Reactors	663
Physics and Core Engineering	663
Control Elements, Systems, and Instrumentation	664
Containment Systems, Shielding, Waste Processing, and Radiation Protection	664
Cooling Systems	664
Fuel Systems and Components	664
Auxiliary Systems, Protection Systems, and Engineered Safeguards	664
Operation and Economics	665
Safety and Siting	666
Propulsion and Auxiliary Power Reactors	669
Research and Test Reactors	669
Reactor Components, Fuels, and Accessories	672
Reactor Physics and Core Engineering	672
Physics	672
Core Thermal Hydraulics	673
GENERAL	674
Law	674
Management	674
Mathematics and Computers	674
Miscellaneous	674
CORPORATE AUTHOR INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-8
SUBJECT INDEX	INDEX-63
REPORT NUMBER INDEX	INDEX-151

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Volume 27, Number 3 February 15, 1973

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

4918 (AEC-tr-7102/5-6) NUKLEONIKA. Translation of Nukleonika; 15, No. 5-6, 417-98(1970). 76p. (TT-70-55010/5-6). Dep. NTIS.

Analytical Chemistry

Refer also to abstracts 5056, 5735–5739, 5742–5746, 5748, and 5751.

4919 (NBL-265) ANNUAL PROGRESS REPORT FOR THE PERIOD JULY 1971–JUNE 1972. Bingham, C. D. (New Brunswick Lab. (AEC), N. J.). Oct 1972. 110p. Dep. NTIS.

Research progress is reported for New Brunswick Laboratory for July 1971 to June 1972. An abstract was prepared for each section. (D.H.M.)

For abstracts of individual sections see: 4939–4959, 4995, 5162, 5163, and 5769.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 5235, 5432, 5578, and 6486.

4920 (BNWL-SA-4434) IN SITU ACTIVATION ANALYSIS OF MARINE SEDIMENTS WITH ^{252}Cf. Wogman, N. A.; Rieck, H. G. Jr.; Kosorok, J. R.; Perkins, R. W. (Battelle Pacific Northwest Labs., Richland, Wash.). 27 Sep 1972. 12p. (CONF-721010-4). Dep. NTIS.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A seabed nuclear probe was developed which permits the measurement of up to 33 elements at the parts per thousand to parts per million levels in continental shelf area. The probe consists of a neutron irradiation source, californium-252, which neutron activates the elements in the minerals of interest. These resulting radioactive elements emit characteristic gamma radiation which is analyzed in situ in 2- to 10-minute counting intervals with a Ge(Li) detector system. Details of the irradiation source, the Ge(Li) detector, and spectra taken in situ in a marine environment are discussed with respect to the detection of the minerals at concentrations of economic interest. (auth)

4921 (INIS-mf-266, pp 2.1-4) LIMITATIONS AND IMPROVEMENTS OF TRACE ELEMENT ANALYSIS WITH PROTON INDUCED X RAYS. Verba, J. W.; Sunier, J. W.; Wright, B. T.; Slaus, I.; Holman, A. B.; Kulleck, J. G. (Univ. of California, Los Angeles). 1971. (CONF-710925-4). INIS.

From International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (5 Sep 1971).

The technique of trace element analysis by detection of characteristic x rays induced by high energy proton bombardment is critically examined. The restrictions imposed by detector resolution are discussed. The behavior of the cross section for x-ray production as a function of energy and atomic number is given. The effect of this behavior on analysis time is demonstrated. Background is discussed in terms of its effect on the total counting rate. The use of a Si(Li) solid-state detector to determine the overlapping K lines of light elements and L lines of heavy elements is shown to have severe limitations. A combination of crystal monochromators and solid-state detectors is suggested as a means to circumvent some of the fundamental limitations encountered with a single detector. An experimental arrangement for the use of twenty-four crystal monochromators and two solid-state detectors is shown. (auth) (INIS)

4922 (INIS-mf-266, pp 14.1-6) MICROANALYSIS OF Si, S, AND Zn IN Ga–Sb BY USE OF DIRECT OBSERVATION OF (p,p′γ) REACTIONS. Chemin, J. F.; Roturier, J.; Saboya, B.; Petit, G. Y. (CEN, Gradignan, France). 1971. (CONF-710925-5). INIS.

From International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (5 Sep 1971).

The uses of direct observation of nuclear reactions (p,p′γ) are discussed. The main characteristics of this method are presented and applied to the case of microanalysis of Si, S, and Zn in Ga–Sb. (auth) (INIS)

4923 (LBL-1240) GLASS BEADS IN AFRICAN ARCHAEOLOGY: RESULTS OF NEUTRON ACTIVATION ANALYSIS, SUPPLEMENTED BY RESULTS OF X-RAY FLUORESCENCE ANALYSIS. Davison, Claire C. (California Univ., Berkeley. Lawrence Berkeley Lab.). Sep 1972. Contract W-7405-eng-48. 371p. Dep. NTIS.

Thesis.

Results are presented of the neutron activation analysis of African glass beads by a method involving two neutron bombardments. The first bombardment is brief and the pills are analyzed immediately after for short-lived isotopes. The second bombardment is intense and lasts for 8 hrs. The pills are set aside for a few days and analyzed for medium-lived isotopes, set aside again, and later analyzed for long-lived isotopes. (D.H.M.)

4924 (PAEC(D)-7114) NEUTRON ACTIVATION ANALYSIS OF URINARY STONES. Lawas, I. O.; del Callar, A.; Feria, J. A. (Philippine Atomic Research Center, Diliman, Quezon City). Dec 1971. 18p. INIS.

A study of the elemental constituents of vesical, urethral, and renal stones using neutron activation analysis techniques is reported. Urinary stone samples used in the study were collected over a period of years. These samples were homogenized, encapsulated and irradiated for 8 hours in a thermal neutron flux of 10^{12} n/cm^2/sec. Then they were irradiated from another 10 hrs in the same flux after cooling them for a day. The following elements, viz., Cr, Mn, Co, Cu, Fe, Zn, Cd, and Mo were separated using the ion exchange procedure developed by Kraus and Nelson. An isotopic exchange method was also developed to remove high Na and K activity. Trace element concentrations were determined using Covell's comparator method and checked with Cali's procedure. The analysis of numerical data from biological samples was made using early observations and on the assumption that the data was normal. It follows, however, that homescedasticity should apply but it could not be ascertained whether this was fulfilled. There is positive correlation between Co and Cu; same relationship is noted between Mo and Zn. An apparent trend towards bimodal distribution was noted. No attempt was made to isolate this trend. The use of relationships within samples enabled the researchers to quantify 5 trace elements in urinary stones. Steps were taken to pinpoint essential correlations between the trace elements studied for their importance in establishing interconnections between dietary intake and urinary excretion of trace elements. Clues on what causes initial deposition of urinary stones in the human system may turn up if these interconnections are established. (INIS)

4925 ANALYSIS OF THE MECHANISMS OF THE POLYMERIZATION BY END GROUP ANALYSIS USING RADIOACTIVE ISOTOPES. Tomono, T.; Yao, T.; Tsuchida, E. (Waseda Univ.,

Tokyo). Kobunshi Kagaku; 29: No. 326, 353-61(Jun 1972). (In Japanese).

Quantitative analysis of the end groups of polymers using tracer and activation analysis are discussed. Principles for measurement, experimental points at issue and applications are outlined. The low-energy β rays from radioactive carbon ^{14}C were used in the tracer method. In activation analysis, γ rays from radioactive chlorine ^{38}Cl were used in order to determine the quantities of the end groups of the polymers. This method was applied to elucidate the mechanisms of the radical oligomerization and the alternating copolymerization of styrene with maleic anhydride in poly-halogenated solvents such as carbon tetrachloride and chloroform. Using ^{14}C contained in the initiators the initiation mechanism was clarified and by use of the (n,γ) reaction of chlorine atoms in the end groups of the polymers the chain-transfer and the termination mechanisms were also made clear. (auth)

4926 NEUTRON ACTIVATION ANALYSIS OF TRACE ELEMENT CONTENT IN SURGICALLY REMOVED SAMPLES OF THE HUMAN BRAIN. Schicha, H. (Kernforschungsanlage, Juelich, Ger.); Mueller, W.; Kasperek, K.; Schroeder, R. Beitr. Pathol.; 146: No. 4, 366-74(1972). (In German).

In order to obtain normal values of trace element concentrations, 17 in vivo tissue samples from human brains, obtained by operation, were examined, including 8 samples from the cerebral cortex and 9 from the cerebral medulla. These data were compared with data from 48 samples from autopsy brain material. The trace elements Co, Fe, Rb, Se, Zn, Ag, Cr, Cs, Sb, and Sc were quantitatively measured by means of neutron activation analysis. The trace element content of Co, Se and Zn was in the cerebral cortex significantly higher than in the medulla. This may be caused by the presence of ganglion cells. The other elements showed no significant differences. The comparison of results of in vivo with autopsy samples showed a diminution of Rb and Co in the latter case. The reason for this reduction may be a postmortal diffusion, especially for Rb, which is biochemically similar to K. Trace element concentrations of human brain are lower than in other organs. (auth)

4927 USE OF ACTIVATION ANALYSIS IN FLUORITE PROSPECTING. Bartosek, J.; Kasparec, I.; Skuthan, B. (Inst. of Applied Geophysics, Prague). Geol. Pruzkum; 12: No. 6, 165-7(Jun 1970). (In Czech).

A method was developed of prompt determination of fluorine and barium in geological samples taken for the purpose of locating fluorite deposits. Barium is significant in view of the fact that fluorite is often accompanied by baryta. The samples (about 2 g) were irradiated for 10 s with a fast neutron beam from a neutron generator. The reactions $^{19}F(n,p)^{19}O$ and $^{138}Ba(n,2n)^{137m}Ba$ were used for determination of the two elements. After the decay of short-lived radionuclides, fluorine and barium concentrations were determined from the intensities of the 197 and 662 keV γ-lines, respectively, measured with a γ-spectrometer. (NSA of Czech.)

4928 CONCENTRATION OF TRACE ELEMENTS IN KIDNEYS OF HYPERTONICS DETERMINED BY NEUTRON ACTIVATION ANALYSIS. Karlicek, V.; Topolcan, O.; Bilkova, L.; Kott, J.; Sova, J. (Charles Univ., Plzen, Czech.). Cas. Lek. Cesk.; 110: No. 32-33, 756-61(13 Aug 1971).

Neutron activation analysis was applied in determining the concentration of ten trace elements in the kidneys of nine tragically deceased healthy persons, nine deceased hypertonics, and twelve normotonics who had died of various diseases. A significantly higher concentration of cadmium and an altered ratio of cadmium and zinc concentrations were found in the kidneys of the hypertonics, while the concentrations of all other studied elements showed no significant differences between hypertonics and normotonics. The analysis of concentrations of cadmium in other ten deceased normotonics and ten hypertonics showed that an increased cadmium content in the kidneys of the hypertonics had resulted from an increased cadmium accumulation in the renal cortex. (NSA of Czech.)

4929 DETERMINATION OF OXYGEN CONTENT IN STEEL BY NEUTRON ACTIVATION ANALYSIS. Mayer, J.; Kasik, I. (Iron Research Inst., Prague). Hutn. Listy; 26: No. 8, 592-5(Aug 1971). (In Czech).

The application of neutron activation analysis was verified in the determination of oxygen in steel at a concentration ranging between 3×10^{-3} and 0.1%. It was based on the $^{16}O(n,p)^{16}N$ reaction measuring the activity in the high energy range above 4 MeV. The comparison of the respective values was obtained by the simultaneous irradiation of the measured and standard samples and the sample for neutron flux monitoring. Steel with a high content of oxygen was used as the standard. The description is given of the laboratory for neutron activation analysis consisting of a NA-2 neutron generator, a deuteron accelerator producing neutrons on the basis of the $T(n,d)^4He$ reaction, a vacuum system, a pneumatic rabbit, a NP-223 gamma spectrometer with a NaI(Tl) crystal, and a 512-channel analyzer NTA-512 with a NK-214 S differential discriminator. The measurement process consisted of the transport of the sample to the generator, activation, transport of the sample to the detector, activity measuring, cooling, and the second activity measuring. At neutron current densities of $\sim 3 \times 10^9$ n/cm^2/sec and in the above oxygen concentration range, the accuracy of the determination increased with the content of oxygen. This varied between 3 and 12%. The time needed for two repeated measuring cycles was 3 minutes, which made the method suitable for checking the technological processes during the steel production. (NSA of Czech.)

4930 APPLICATIONS OF NUCLEAR TECHNIQUES TO MATERIALS ANALYSIS. Bird, J. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights); Campbell, B. J.; Price, P. B.; Scott, M. D. At. Energy Aust.; 15: No. 3, 12-19(Jul 1972).

A number of features of nuclear analysis are described. Neutron and gamma ray methods are not restricted by sample thickness whereas charged particle methods test only a very thin surface or subsurface layer. Charged particle methods are suited to the study of surface phenomena such as contamination, evaporated layers, implanted ions in semiconductors, diffusion studies, oxidation and other applications. Depth analysis and microanalysis scans enhance these applications. Alpha scattering is particularly suitable for estimating small quantities of an isolated heavy element in a matrix of tighter elements, for example Hg and Pb in blood. Because reactions are specific to one isotope they can be applied to the determination of isotope ratios and used in tracing applications with stable enriched isotopes. Specific reactions discussed are photoneutron production, resonance fluorescence, neutron transmission, gamma ray production, charged particle channelling and scattering, and charged particle, neutron and gamma ray production. (Australia)

4931 RADIOACTIVATION ANALYSIS OF ARSENIC. I. EXTRACTION SEPARATION OF MACRO- AND MICROELEMENTS. Kuz'min, N. M.; Vlasov, V. S.; Lambrev, V. G. Zh. Anal. Khim.; 27: No. 8, 1614-16(Aug 1972). (In Russian).

The extraction of arsenic(III) halides in the benzene–hydrochloric (sulfuric) acid system was studied. A method is suggested for the radioactivation analysis of arsenic for Au, Ga, Fe, Cr, In, Cu, Zn, Mn, and Ni. The sensitivity of the determination of separate elements is 10^{-4} to 10^{-7}%. (auth)

4932 ACTIVATION ANALYSIS TRACE-ELEMENT STUDIES OF MARINE BIOLOGICAL SAMPLES. de Goeij, J. J. M. (Interuniversity Reactor Inst., Delft, Netherlands); Guinn, V. P.; Young, D. R. Trans. Amer. Nucl. Soc.; 15: No. 2, 642(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

4933 NUCLEAR ACTIVATION ANALYSIS OF Se, As, Zn, Cd, AND Hg IN ENVIRONMENTAL MATRICES. Orvini, E.; Gills, T. E.; LaFleur, P. D. (National Bureau of Standards, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 642-3 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

4934 ACTIVATION ANALYSIS OF HEAVY METALS IN SURFACE WATERS USING ION EXCHANGE FILTER PAPER AND CYANIDE COMPLEXING. Kolaczkowski, A. M. (Gulf General Atomic Co., San Diego, Calif.); Jester, W. A. Trans. Amer. Nucl. Soc.; 15: No. 2, 643-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

4935 TWO NEW INSTRUMENTS FOR NONDESTRUCTIVE FUEL ASSAY WITH NEUTRONS. Boehnel, K. (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 2, 671-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

4936 OPTIMUM PROCEDURE FOR DETERMINATION OF ^{77m}Se IN BIOLOGICAL SPECIMENS. Blotcky, A. J.; Arsenault, L. J.; Rack, E. P. (Veterans Administration Hospital, Omaha). Trans. Amer. Nucl. Soc.; 15: No. 2, 714-15(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

4937 COLLECTION AND ACTIVATION ANALYSIS OF AIRBORNE GUNSHOT RESIDUES. Renfro, W. B. (Wright Patterson AFB, Ohio); Jester, W. A. Trans. Amer. Nucl. Soc.; 15: No. 2, 718-19(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Chemical and Spectral Procedures

Refer also to abstracts 5015 and 5124.

4938 (ARH-SA-96) FLUORIDE SEPARATION BY MICRODIFFUSION AND DETERMINATION BY FLUORIDE SPECIFIC ION ELECTRODE. Winters, W. I. (Atlantic Richfield Hanford Co., Richland, Wash.). Jun 1971. Contract AT(45-1)-2130. 27p. (CONF-710658-2). Dep. NTIS.

From 26th northwest regional meeting of American Chemical Society; Bozeman, MT. (16 Jun 1971).

Microdiffusion was found to be a fast and convenient method for separating trace quantities (2 μg) of fluoride from nuclear processing solutions. The tolerance levels for 17 interfering elements were studied including uranium and thorium. Both sulfuric and phosphoric acids were investigated as distillation mediums. When used in conjunction with the fluoride specific ion electrode, the technique offers several advantages over other distillation, pyrohydrolysis, and spectrophotometric techniques: smaller quantities of fluoride may be separated; a large number of samples may be analyzed at one time; less training is required and it is less subject to operator errors and operating parameters; the diffusion apparatus is disposable, eliminating the need for expensive apparatus and decontamination of equipment; and the method is adaptable to glove box and hot cell operations. (auth)

4939 (NBL-265, pp 5-20) AUTOMATIC TITRIMETRIC DETERMINATION OF URANIUM BY THE CONSTANT CURRENT GENERATION OF VANADIUM(V). Goldbeck, C. G.; Lerner, M. W. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

An automatic instrument for determining uranium based upon the constant-current generation of vanadium(V) was designed and constructed. Some evaluation studies of the instrument are presented. (auth)

4940 (NBL-265, pp 21) AUTOMATIC INSTRUMENT FOR THE NEW BRUNSWICK LABORATORY TITRIMETRIC METHOD FOR DETERMINING URANIUM: A CONTINUING EVALUATION. Clickner, M. R. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

The precision and accuracy of the results obtained with the automatic instrument for determining uranium based upon dichromate titration were determined for an additional 7-month period. No serious maintenance problems arose during this period. (auth)

4941 (NBL-265, pp 22-5) STUDY OF THE ELIMINATION OF THE MANGANESE INTERFERENCE IN THE NEW BRUNSWICK LABORATORY TITRIMETRIC METHOD OF DETERMINING URANIUM. Bodnar, L. Z.; Scarborough, J. M.; Lerner, M. W. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

The elimination of manganese interference with the New Brunswick Laboratory titrimetric method of determining uranium by fuming the sample with sulfuric, perchloric, or phosphoric acid was found to be successful only when nitrate was initially present in the sample. (auth)

4942 (NBL-265, pp 26-7) EFFECTS OF IMPURITIES ON THE DETERMINATION OF URANIUM BY THE NEW BRUNSWICK LABORATORY TITRIMETRIC METHOD. Scarborough, J. M. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

A systematic study of the effect of impurity cations and anions on the New Brunswick Laboratory titrimetric method of determining uranium was initiated. The effects of copper, titanium, cobalt, nickel, cerium, and samarium are described. (auth)

4943 (NBL-265, pp 34-8) DETERMINATION OF FREE CARBON IN BORON CARBIDE: A PROGRESS REPORT. Tarr, T. D. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

Preliminary tests are described on the development of a method to determine free carbon in boron carbide by the selective oxidation of the carbon with an oxygen plasma oxidizer. (auth)

4944 (NBL-265, pp 39-43) PRELIMINARY EVALUATION OF A RAPID MASS SPECTROMETRIC METHOD OF DETERMINING BORON ISOTOPIC ABUNDANCE IN BORON CARBIDE. Summers, A. W. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

A procedure involving the formation of the charge material sodium tetraborate directly on the mass spectrometer filament was evaluated for the isotopic analysis of boron in boron carbide. The procedure shows a standard deviation of 0.004 in the $^{11}B/^{10}B$ ratio and a bias of +0.24% when compared to the conventional method of preparing the charge material based on a sodium carbonate fusion, ion-exchange separation of the boric acid, and treatment of the boric acid solution with sodium hydroxide. (auth)

4945 (NBL-265, pp 44-7) CURRENT EVALUATION OF THE ISOTOPE DILUTION MASS SPECTROMETRIC PROCEDURE FOR DETERMINING URANIUM AND PLUTONIUM. Puleio, P. C.; Pietri, C. E.; Wenzel, A. W.; Greer, R. J.; Peoples, G. E.; Summers, A. W. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

The precision and accuracy of the New Brunswick Laboratory isotope dilution mass spectrometric procedure for determining uranium and plutonium concentrations were determined under routine operating conditions over an extended period of time. The relative standard deviation of the uranium and plutonium results are 0.40 to 0.20%, respectively; the accuracy, expressed as the relative average difference between the prepared and found values, are +0.040% and +0.035%, respectively, with no bias at the 95% C.L. (auth)

4946 (NBL-265, pp 48-50) IMPROVED VACUUM LOCK FOR A THERMAL-IONIZATION SOURCE MASS SPECTROMETER. Callis, E. L.; Summers, A. W.; Connolly, V. E.; Puleio, P. C. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

The vacuum lock designed and constructed by the New Brunswick Laboratory for use on each of two thermal ionization mass spectrometers was modified for operation on a tandem instrument used chiefly for the analysis of plutonium and ^{233}U samples. (auth)

4947 (NBL-265, pp 51-2) PREPARATION OF URANIUM CHARGE MATERIAL FOR MASS SPECTROMETRIC ISOTOPIC ANALYSIS. Holub, A. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

Improved procedures for the separation of uranium for mass spectrometric isotopic analysis are described. These procedures are more rapid and require less handling of the sample than those previously reported. (auth)

4948 (NBL-265, pp 53-4) SPARK-SOURCE MASS SPECTROMETRIC DETERMINATION OF IMPURITIES IN URANIUM HEXAFLUORIDE IN THE GASEOUS PHASE. Callis, E. L. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

A method for the spark-source mass spectrometric determination of impurities in uranium hexafluoride is being developed. The method will involve the introduction into the instrument of the sample in the gaseous phase. (auth)

4949 (NBL-265, pp 55-7) SECONDARY CONTROLLED-POTENTIAL COULOMETRIC DETERMINATION OF CHROMIUM(VI) WITH IRON AS AN INTERMEDIATE. Lewis, K. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

The controlled-potential coulometric reduction of chromium(VI) was studied. A method was developed for the reduction that involves a secondary coulometric technique with iron as an intermediate. (auth)

4950 (NBL-265, pp 58-60) EFFECT OF RESIDUAL OXYGEN AND ELECTRODE TREATMENT ON THE CONTROLLED-POTENTIAL COULOMETRIC DETERMINATION OF IRON. Lewis, K. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

The adverse effects of residual oxygen and nitric acid treatment of the platinum working electrode on the controlled-potential coulometric determination of iron were studied. With the recommended method of deaeration and freshly prepared electrolyte solutions, these difficulties are eliminated. (auth)

4951 (NBL-265, pp 61-4) SEPARATION OF ANTIMONY FROM URANIUM BY COLLECTION ON MANGANESE DIOXIDE: AN EVALUATION. Hedrick, C. E. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

A procedure reported in the literature for the separation of antimony from uranium and other elements by collection on a manganese dioxide precipitate prior to the spectrophotometric determination of antimony was evaluated. Only about 45% recovery of the antimony was obtained and bismuth, which interferes with the spectrophotometric measurement, was not separated. (auth)

4952 (NBL-265, pp 65-9) ATOMIC ABSORPTION SPECTROPHOTOMETRIC DETERMINATION OF IMPURITIES IN ELEMENTAL BORON. Graff, R. L. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

An improved atomic absorption spectrophotometric determination of impurities in elemental boron is reported. In this procedure, the boron is removed by volatilization as the methyl ester

from the solution prepared by dissolving the sample in mixed acids. The removal of the boron results in greater sensitivity in determining many impurity elements. (auth)

4953 (NBL-265, pp 70-3) EVALUATION OF A DEUTERIUM-ARC BACKGROUND CORRECTOR FOR THE ATOMIC ABSORPTION SPECTROPHOTOMETRIC DETERMINATION OF IMPURITIES IN URANIUM SOLUTION: A PROGRESS REPORT. Graff, R. L. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

A Perkin–Elmer Deuterium-Arc Background Corrector was briefly evaluated by analyzing uranium standards for impurities. The Corrector improved the results for certain impurities and had little effect on others. More comparisons are planned in future work. (auth)

4954 (NBL-265, pp 74-81) DETERMINATION OF ^{235}U ISOTOPIC ABUNDANCE WITH THE INTERFERENCE SPECTROMETER: A PROGRESS REPORT. Yuster, H. G. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

Studies were initiated on the determination of the ^{235}U abundance by means of the interference spectrometer. An empirical equation for the calculation by a computer of ^{235}U abundance up to 10% from the ^{235}U and ^{238}U recorder trace peak heights was developed. (auth)

4955 (NBL-265, pp 82-6) COBALT AS A SPECTROCHEMICAL INTERNAL STANDARD. Graff, R. L.; Yuster, H. G.; Nelson, L. C. Jr. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

The reliability of cobalt as an internal standard for the spectrochemical determination of impurities in uranium and thorium was studied. Despite the fact that cobalt volatility decreases with an increase in total impurity concentration, the determination of most impurities is helped by its use. (auth)

4956 (NBL-265, pp 87-9) DETERMINATION OF PLUTONIUM AND URANIUM IN PLUTONIUM DIOXIDE–URANIUM DIOXIDE–DYLENE MIXTURES. Trahey, N. M.; Peoples, G. E.; Wenzel, A. W.; Pietri, C. E. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

Analyses of synthetic PuO_2-UO_2–Dylene (polyethylene) mixtures for uranium and thorium by titrimetric methods indicate that the determination of these elements in actual samples of this type would be satisfactory. (auth)

4957 (NBL-265, pp 90-3) ADJUSTMENT OF PLUTONIUM OXIDATION STATE BY FERROUS AND DICHROMATE ION TREATMENT: A PRELIMINARY STUDY. Minns, J. L.; Wenzel, A. W.; Hedrick, C. E.; Pietri, C. E. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

A study was made of the adjustment of plutonium in solution to the plutonium(IV) oxidation state by treatment with ferrous and dichromate ion and amperometric or potentiometric detection of the changes involved at each step. After adjustment to the plutonium(IV) oxidation state, the ion exchange separation is applied, and the plutonium is determined by titration. (auth)

4958 (NBL-265, pp 94-9) CONTROLLED-POTENTIAL COULOMETRIC DETERMINATION OF PLUTONIUM AFTER ION-EXCHANGE SEPARATION IN MINI-COLUMNS. Weiss, J. R.; Pietri, C. E.; Wenzel, A. W.; Nelson, L. C. Jr. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

A controlled-potential coulometric procedure for determining 5-mg quantities of plutonium was developed involving the use of mini-columns for the ion-exchange separation and a novel method of adjusting the plutonium to the plutonium(IV) oxidation state prior to separation. (auth)

4959 (NBL-265, pp 100-1) DETECTION OF URANIUM IN ION-EXCHANGE EFFLUENTS. Trahey, N. M. Oct 1972.

In Annual progress report for the period July 1971–June 1972.

A colorimetric test with a minimum of pretreatment was developed to detect uranium in ion-exchange effluents. (auth)

4960 NEWCASTLE CONFERENCE, 1972. Conference Held at Melbourne, May 28–June 2, 1972. Parkville, Australia; Australasian Institute of Mining and Metallurgy (1972). 369p. (CONF-720550).

Thirty-seven papers are included on coal geology, coal bore cores, sulfide genesis, coal mining, blending and sintering, iron and steel, cokemaking, continuous casting, ferrous and nonferrous refining, rare earths, and milling. A separate abstract was prepared for one paper. (M.C.G.)

For an abstract of an individual paper see: 4961.

4961 ELECTROPHORETIC ANALYSIS APPLIED TO THE RARE EARTH CONTENT AND ORIGIN OF THE MONAZITES OF NEW SOUTH WALES. Bourke, E. J.; Ritchie, A. S. (Univ. of Newcastle upon Tyne, Eng.). pp 311-18 of Newcastle Conference, 1972. Parkville, Australia; Australasian Institute of Mining and Metallurgy (1972).

From Newcastle conference; Melbourne, Australia (28 May 1972). See CONF-720550.

The principles of chromatographic and electrophoretic separations are described. Brief details of the analytical procedures and of equipment are given. Partial analyses of rare earth elements in monazites from four localities in New South Wales are compared with analyses from other localities. The presence of uranium in two of the monazites is recorded. The occurrence of rare earths in nature is outlined and its geological significance is indicated. A low capital cost method of analysis of rare earths in monazites is introduced. (auth)

4962 POLAROGRAPHIC DETERMINATION OF Nb IN TITANIUM OXIDE. Desquesnes, W.; Urbain, H. (CNRS, Villeurbanne, France). Analusis; 1: No. 1, 34-9(Apr 1972). (In French).

A method is proposed for the determination of small amounts of Nb in titanium oxide. The niobium is determined by polarography in an EDTA medium after dissolution in hydrofluoric acid and extraction with methyl isobutyl ketone. The factors likely to effect this determination are studied; the experimental conditions are outlined. The simultaneous determination of Nb and Ti is also described. (France)

4963 POTENTIOMETRIC DETERMINATION OF URANIUM WITH COBALT(III) ACETATE AS OXIDIMETRIC TITRANT. Hanif, M.; Parveen, I.; Zyka, J. (Pakistan Council of Scientific and Industrial Research Labs., Lahore). Chem. Anal. (Warsaw); 17: No. 4, 1119-23(1972).

A potentiometric method for the determination of uranium by reduction from hexavalent to tetravalent state and its potentiometric oxidation in 8N sulfuric acid with standard cobalt(III) acetate was worked out. The method is quite accurate with the error not exceeding ±1% for mg amounts. Moreover an apparatus for preservation of reduced solution of uranium and its delivery for titrations was designed. The same apparatus can be used for reducing and preserving solutions of strong reducing titrants. (auth)

4964 USE OF CATALYTIC REACTIONS OF OXIDATION WITH MANGANESE(III) FOR THE DETERMINATION OF MICRO-AMOUNTS OF IRIDIUM AND RUTHENIUM BY KINETIC METHOD. Yatsimirskii, K. B.; Tikhonova, L. P.; Goncharik, V. P.; Kudinova, G. V. (Inst. of Physical Chemistry, Kiev). Chem. Anal. (Warsaw); 17: No. 4, 789-802(1972). (In Russian).

Manganese(III) in solutions of sulfuric and perchloric acids is in the form of hydroxyaquocomplexes or aquocomplexes. The kinetics of oxidation of mercury(I) with these solutions was examined. The reaction is catalyzed by iridium compounds. The reduction of Mn(III) with the products of p-anisidine oxidation, which is catalyzed by ruthenium compounds was also examined. A mechanism for these catalytic reactions is suggested. The reactions were employed for the determination of traces of iridium (0.2 μg/ml) and ruthenium (0.005 μg/ml), respectively. The reaction used for the determination of iridium is also catalyzed by osmium and ruthenium, so these elements must be previously removed. The reaction used for the determination of ruthenium is specific for this element. (auth)

4965 EMISSION SPECTROSCOPY OF ATOMS IN THE SECONDARY INTERCONAL ZONE OF THE ARGON–OXYGEN–ACETYLENE FLAME. Alder, J. F.; Thompson, K. C.; West, T. S. (Imperial Coll. of Science and Tech., London). Chem. Anal. (Warsaw); 17: No. 4, 1091-1100(1972).

A study was made of the reducing and excitation properties of the secondary interconal region of the fuel-rich oxygen-argon-acetylene flames. Limits of detection were found for some 20 elements and compared with the limits in the fuel-rich nitrous oxide-argon-acetylene and various other flames. Better detection limits were obtained for metals such as Be, Ge, Mo, Sn, Te, V, and Zr, which form refractory oxides in the secondary interconal zone of the oxygen–argon–acetylene flame than in the nitrous oxide–argon–acetylene flame. (auth)

4966 TRACE ANALYSIS BY MASS SPECTROMETRY. Ahearn, A. J. (ed.). New York; Academic Press, Inc. (1972). 471p. $22.50.

The trace analysis of solids and liquids by mass spectrometric techniques is surveyed. Five of the chapters have been abstracted separately for NSA. The remaining chapters deal with the basic physics of electrical discharge ion sources, double focusing mass

spectrometry, and the measurement of arrays of mass resolved ion beams by electrical detection methods and with ion sensitive emulsions. Also included are discussions of surface and thin films analysis and laser ion source analysis of solids. (J.G.B.)

For abstracts of individual chapters see: 4967, 4968, 4969, 4991, and 4992.

4967 INSULATORS, POWDERS, AND MICROSAMPLES. Morrison, G. H.; Roth, J. R. (Cornell Univ., Ithaca, NY). pp 297-322 of Trace Analysis by Mass Spectrometry. /Ahearn, A. J. (ed.). New York; Academic Press, Inc. (1972).

Methods and techniques for the analysis of insulators, powders, and microsamples are reviewed. Various materials are discussed, including geological materials, biological materials, and rare earth metals and oxides. Trace element concentrations, including U, Th, and rare earths, in standard granites are tabulated. (48 references) (J.G.B.)

4968 ANALYSIS OF LOW-MELTING AND REACTIVE SAMPLES. Hickam, W. M.; Berkey, E. (Westinghouse Research Labs., Pittsburgh). pp 323-45 of Trace Analysis by Mass Spectrometry. /Ahearn, A. J. (ed.). New York; Academic Press, Inc. (1972).

The following topics are discussed: sodium sampling and handling techniques; analysis of sample; results and discussion, including a section on reactor grade sodium; and on-stream analysis by spark-source mass spectrometry. (26 references) (J.G.B.)

4969 ANALYSIS OF RADIOACTIVE SAMPLES BY SPARK-SOURCE MASS SPECTROMETRY. Carter, J. A.; Sites, J. R. (Oak Ridge National Lab., TN). pp 347-67 of Trace Analysis by Mass Spectrometry. /Ahearn, A. J. (ed.). New York; Academic Press, Inc. (1972).

Protective measures that must be taken in the analysis of radioactive samples by spark-source mass spectrometry are discussed in the sections on terminology and basic concepts, units and sample calculation, radiation protection instrumentation, and source and glove box containment. Methods for the analysis of uranium, plutonium, and americium metal are reviewed. Relative sensitivity factors for the lanthanides, actinides, and other common inorganic impurities are tabulated. (29 references) (J.G.B.)

4970 DETERMINATION OF HALOGENS BY THE AMMONIA METHOD IN ORGANIC SUBSTANCES CONTAINING SEVERAL PRESENT TOGETHER HALOGENS. Volodina, M. A.; Moroz, N. S.; Kiseleva, V. I. (Moscow State Univ.). Zh. Anal. Khim.; 27: No. 8, 1639-42(Aug 1972). (In Russian).

A method is suggested for differential determining halogens that are present together in different organic substances including readily volatile and sulfur-containing ones. The method is based on heating the sample in the current of ammonia at 850° followed by potentiometric titration of the mixture of ammonium halides with silver nitrate in a mixture of solvents (water–acetic acid–acetone). (auth)

4971 SPECTROGRAPHIC DETERMINATION OF ADMIXTURES IN CADMIUM AND ZINC ELECTROLYTES OF HIGH PURITY. Larina, L. K.; Makartseva, V. N.; Belenkova, N. S. (All-Union Scientific-Research Mining and Metallurgical Inst. of Non-Ferrous Metals, Ust-Kamenogorsk, USSR). Zh. Anal. Khim.; 27: No. 8, 1634-6(Aug 1972). (In Russian).

A direct spectrographic method was suggested for determining 15 elements-admixtures in cadmium and zinc electrolytes of high purity. The sensitivity is $1 \cdot 10^{-5}$ to $1 \cdot 10^{-4}$ g/l. (auth)

4972 DETERMINATION OF A PRASEODYMIUM ADMIXTURE IN YTTRIUM OXIDE BY A LUMINESCENT METHOD. Poluektov, N. S.; Smirdova, N. I.; Efryushina, N. P. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 27: No. 8, 1616-20(Aug 1972). (In Russian).

A method was worked out for determining a praseodymium admixture in yttrium oxide with the use of its luminescence in an yttrium oxyfluoride-based crystallophosphorus. The sensitivity is 3×10^{-5}% Pr_6O_{11} in Y_2O_3. The variation coefficient is 3 to 8%. (auth)

4973 PHOTOMETRIC DETERMINATION OF NEPTUNIUM AS ITS PEROXIDE COMPLEX. Novikov, Yu. P.; Ivanova, S. A.; Bezrogova, E. V.; Nemodruk, A. A. Zh. Anal. Khim.; 27: No. 8, 1512-16(Aug 1972). (In Russian).

The interaction of neptunium in different valent states with hydrogen peroxide in wide ranges of concentrations of acids and bases was studied. The formation of an intensively colored peroxide complex of neptunium in alkaline solutions was established. A ratio of Np(V) to H_2O_2 in the complex was found to be 1 : 1. The molar extinction coefficient at 430 nm is 5010 ± 210, at 370 nm—7950 ± 350. A highly selective photometric method is suggested for determining microamounts of neptunium as its peroxide complex. (auth)

4974 USE OF EXTRACTION CHROMATOGRAPHY FOR QUANTITATIVE SEPARATION OF RARE METALS FROM ADMIXTURES OF OTHER ELEMENTS. I. SEPARATION OF TANTALUM. Goryanskaya, G. P.; Kaplan, B. Ya.; Kovalik, I. V.; Merisov, Yu. I.; Nazarova, M. G. (State Scientific-Research and Design Inst. of Rare Metal Industry, Moscow). Zh. Anal. Khim.; 27: No. 8, 1498-1502(Aug 1972). (In Russian).

The extraction-chromatographic separation of tantalum in the 100% TBP–1 N HF + 1 N HNO_3 system on a column packed with porous teflon was used for concentration of microadmixtures in analysis of tantalum of high purity. A chemical-spectral method was developed for determining Al, Fe, V, Ca, Mg, Mn, Cu, Mo, Ni, Nb, Sn, Pb, Ti, Cr, Zr in tantalum with the sensitivity of 2×10^{-4} to 6×10^{-7}%. (auth)

4975 POLAROGRAPHIC PROPERTIES OF COMPLEXES OF ALKALI METALS IN AQUEOUS SOLUTIONS. Bobrovski, A.; Zarembski, Yu. (Mining and Metallurgical Academy, Krakow). Zh. Anal. Khim.; 27: No. 8, 1472-9(Aug 1972). (In Russian).

Complexes of alkali metals were studied polarographically using direct and alternating current. Solutions of $(CH_3)_4NOH$ containing such additives as ethylenediaminetetraacetic acid (EDTA), 1,2-diaminocyclohexano-N,N,N',N'-tetraacetic acid (DCTA) ethyleneglycol-di-(2-aminoethyl)-tetraacetic acid, nitriletriacetic acid, and uramile-N,N-diacetic acid were used for the determination. A pure solution of $(CH_3)_4NOH$ was used for comparison. Lithium, sodium, and potassium ions form complex compounds that result in shifting half-wave potentials to a region of their more negative values. Complexes of alkali metals are reduced reversibly with participating one electron. Stability constants of the complexes were calculated. Simultaneous determination of Na and Li, K and Li, Rb and Li, Cs and Li, Li in the presence of a mixture of Na, K, Rb and Cs can be carried out polarographically in a solution of $(CH_3)_4NOH$ in the presence or in the absence of EDTA using direct and alternating current. Alternating current polarography can be used for determining ions of Na and K, Na and Rb, Na and Cs in a solution of $(CH_3)_4NOH$ in the presence of DCTA. (auth)

4976 MICRODETERMINATION OF SOLUBLE IODIDES IN BIOLOGICAL FLUIDS. Barakat, M. Z.; Bassioni, M.; El-Wakil, Mamdouh (Azhar Univ., Cairo). Microchem. J.; 17: No. 5, 568-75(Oct 1972).

A modified titrimetric method for microdetermination of soluble iodides, e.g., potassium iodide or sodium iodide, is described. The mechanism of the reaction between N-bromosuccinimide and potassium iodide in aqueous solution is discussed. The determination is done within the range from 10 mg to 50 μg for soluble iodides. The experimental error does not exceed ±2%. Comparative analysis of potassium iodide by the proposed method and the official potassium iodate method is reported. The method was applied to determine potassium iodide in biological fluids within the limits of 10 to 1 mg giving satisfactory results. (auth)

4977 SIMPLE MATHEMATICAL MODELS FOR NONDISPERSIVE X-RAY FLUORESCENCE GAUGES. Gardner, R. P.; Verghese, K.; Betel, D. (North Carolina State Univ., Raleigh). Trans. Amer. Nucl. Soc.; 15: No. 2, 708-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

4978 METHOD FOR THE SEPARATION OF CARBON FROM ALKALI AND ALKALINE EARTH METALS. Jung, J. (to Internationale Atomreaktorbau GmbH). German Patent 2,036,558. 3 Feb 1972. (In German).

A method is proposed for the removal of carbon from liquid metals (e.g., sodium in nuclear technology) and, simultaneously, for the detection and measurement of the carbon activity. For this purpose, hydrogen or a hydrogen-containing gas is passed through the liquid metal which then reacts chemically with carbon forming methane. The reaction gas is separated from the metal in the usual manner. Nonconverted hydrogen is removed by a permeable membrane by this gas. Having passed through a trap for the separation of metal impurity, the methane gas is led into a measuring device and the concentration is determined. A flame ionization detector or a gas chromatograph may be used for this purpose. (GF)

4979 MICROMETHODS IN QUANTITATIVE ORGANIC ANALYSIS IN USE BY THE DEPARTMENT OF MICROANALYSIS OF THE ISTITUTO SUPERIORE DI SANITA. Marzadro, Margherita; Zavattiero, Jone; Mazzeo Farina, Anna (Istituto Superiore di Sanita, Rome). Ann. Ist. Super. Sanita; 8: No. 1, 3-77 (1972). (In Italian).

Methods and special equipment are described in detail for microdeterminations of C, H, N, O, the halogens Cl, Br, I, and F, S, P, B, Hg, and the several metals encountered in organic compounds: the alkali metals, Mg, Ca, Ba, Mn, Zn, Co, Cd, Fe, Bi, Cu, Cr, Al, and Pt. The techniques include gravimetry, conductimetry, combustion (wet and dry), and titrimetry. The iodine determinations are based either on combustion of the organic compound in O_2 and absorbing the I_2 in 5% NaOH, or on a wet combustion by means of HNO_3. (K.S.W.)

4980 NEW RARE EARTH ELEMENT STANDARDS FOR ELECTRON MICROPROBE ANALYSIS. Drake, M. J.; Weill, D. F. (Univ. of Oregon, Eugene). Chem. Geol.; 10: No. 2, 179-81(Oct 1972).

Four rare earth element microprobe standards were prepared. The base is a synthetic Ca–Al silicate glass to which 3 to 4 weight % REE is added. The compositions of the standards were independently confirmed by instrumental neutron activation analysis. The standards are available upon request. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 5346, 5555, and 5732.

4981 (CEA-N-1190) RADIOISOTOPIC APPARATUS FOR ANALYZING LOW ATOMIC NUMBER ELEMENTS BY FLUORESCENCE. Robert, A.; Martinelli, P.; Daniel, G.; Laflotte, J. L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct 1969. 21p. (In French). Dep. NTIS (U. S. Sales Only).

An apparatus is described for analyzing light elements of atomic number between 6 and 24 by x-fluorescence. The samples are excited by means of x or α isotopic sources. Various examples of analytical determinations are given. (auth)

4982 (KFK–1491) ANALYSIS OF SILICON NITRIDE LAYERS DEPOSITED FROM SiH_4 AND N_2 ON SILICON. Meyer, O.; Scherber, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Aug 1971. 7p. INIS.

Backscattering and channeling effect measurements of 1-MeV $^4He^+$ ions were used to determine the composition and density of Si_xN_y layers on single crystal silicon. The nitride layers were deposited by the reaction between SiH_4 and N_2 in a glow discharge at 350°C. The ratio N/Si in the layer decreases with increasing SiH_4 concentration and total pressure of the reaction gases whereas the density is nearly constant. Conditions for deposition of stoichiometric nitride layers were optimized. These results are in good agreement with measurements of etching rate and index of refraction. The composition of all samples is homogeneous over the entire layer. (INIS)

4983 (SC-RR–720722) MEASUREMENT OF TRACE COPPER IMPURITIES IN BERYLLIUM FOILS UTILIZING X-RAY FLUORESCENCE SPECTROSCOPY. Hohlfelder, J. J.; Glibert, K. M. (Sandia Labs., Albuquerque, N. Mex.). Dec 1972. 15p. Dep. NTIS.

The abundance of a trace copper impurity in a beryllium foil has been measured by utilizing x-ray fluorescence spectroscopy. This result is compared with a destructive measurement of the copper in the same foil which utilized chemical methods. A 25-mCi ^{109}Cd source was used to excite the fluorescence. (auth)

4984 LOW LEVEL TRITIUM AND ^{14}C DETERMINATION. Larsson, S. (Univ. of Goteborg). Anal. Biochem.; 50: No. 1, 245-54(Nov 1972).

A description is given of a Geiger–Müller (GM) tube which operates on the principle that the tritium-labeled sample which is first combusted to the free gas is counted inside the tube. The tube is described, together with its counter, in detail. This tube allows the measurement of low tritium and ^{14}C activities with an efficiency of 93%. The background of the counting system is 2.3 cpm, with a S.D. of ±0.03. With the level of significance set at five times the S.D. of the background, this system has a lower detectable limit of about 0.15 cpm. (auth)

4985 ESTIMATION OF RADIOACTIVITY IN ELECTROPHORESIS GELS BY A SCANNING SEMICONDUCTOGRAPHIC PROCEDURE. Tykva, R.; Votruba, I. (Inst. of Organic Chemistry and Biochemistry, Prague). Anal. Biochem.; 50: No. 1, 18-27(Nov 1972).

A fully automatized procedure for determination of radioactivity in a polyacrylamide gel is described that utilizes a semiconductor detector and a selectable preset program. This method is simple, provides high resolution, and permits either stepwise or continuous registration of radioactivity. The record of radioactivity is displayed both graphically and numerically. Partially depleted surface barrier silicon detectors are used for the measurement. In view of the high-energy resolution of the semiconductor detectors, the procedure is particularly suitable for the determination of two or more radionuclides present simultaneously in a gel. A quantitative comparison with results obtained with a liquid scintillation spectrometer and with a windowless flow counter is presented. (auth)

4986 GAS–LIQUID RADIOCHROMATOGRAPHY OF ^{14}C-CONTAINING COMPOUNDS WITH COMBUSTION AND COLLECTION OF THE RESULTING [^{14}C]CARBON DIOXIDE IN HYAMINE. Trenner, N. R.; Speth, O. C.; Gruber, V. B.; Vandenheuvel, W. J. A. (Merck Sharp and Dohme Research Labs., Rahway, N. J.). J. Chromatogr.; 71: No. 3, 415-20(20 Sep 1972).

A new approach is reported for the gas–liquid radiochromatography of ^{14}C-containing compounds. The column effluent is split between a mass detector and a combustion system, and the [^{14}C] carbon dioxide arising from the individual chromatographic components is trapped in vials containing Hyamine. Each vial is then subjected to conventional radioassay by liquid scintillation counting. Applications of this approach to biosynthesis and drug metabolism problems are presented. (auth)

4987 QUANTITATIVE X-RAY ANALYSIS. Pape, A.; Sens, J. C.; Fintz, P.; (and others) (CRN, Strasbourg). Nucl. Instrum. Methods; 105: No. 1, 161-2(1972).

The addition of a known concentration of cesium ion to a solution to be analyzed was used to determine quantitatively the other elements present in x-ray analysis. (1 figure) (auth)

4988 QUANTITATIVE ANALYSIS OF ANTIDEGRADANTS IN RUBBER VULCANIZATES BY RADIOISOTOPE DILUTION METHOD. Murakami, S. (Ohtsu Tire and Rubber Co. Ltd., Izumiotsu, Japan); Fujii, Y.; Tsurugi, J.; Hamada, M.; Nakabayashi, T. Kobunshi Kagaku; 29: No. 326, 431-5(Jun 1972). (In Japanese).

A new method of quantitative analysis for amine-type antidegradants in rubber vulcanizates was established by isotope dilution method using ^{14}C-labeled antidegradants. The ^{14}C-labeled antidegradant of a known radioactivity was added to the acetone extract obtained from vulcanization containing nonlabeled antidegradant. The reduced specific radioactivity of the pure antidegradant separated from the mixture enabled us to calculate the original amount of the antidegradant in the vulcanizate. This method was applied to aged vulcanizates and tire treads. (auth)

4989 USE OF RADIONUCLIDE SOURCES OF CHARACTERISTIC RADIATION IN X-RAY FLUORESCENCE DETERMINATION OF ZINC IN PHARMACY. Svitel, J.; Zatloukal, Z. (Comenius Univ., Bratislava). Farm. Obz.; 40: No. 4, 151-7(1971). (In Slovak).

A possible use was studied of new radionuclide sources of characteristic radiation in x-ray fluorescence determination of zinc in drugs and pharmaceuticals. $^{147}Pm/Mo$, $^{147}Pm/Ag$, and $^{147}Pm/Te$ sources were used. The characteristic x-ray fluorescence radiation of zinc was separated by pulse-height selection and by Ross filters. (NSA of Czech.)

4990 DIRECT DETERMINATION OF THE ^{90}Sr-DISTRIBUTION IN PYROLYTIC CARBON-LAYERS FROM THE COMPLEX FISSION-PRODUCT BETA-RAY SPECTRUM. Mioduszewski, P.; Bueker, H. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie; 20: No. 2, 143-8(1972). (In German).

Under reactor safety aspects the nuclide ^{90}Sr is a very important fission product. It is very dangerous, because it has a great fission yield, a long lifetime, and will be easily absorbed by animals and human beings. After absorption it will be deposited in the bones. In the marrow of the bones ^{90}Sr can cause great damages by its beta-rays. This is the reason that it must be prevented that ^{90}Sr penetrates the fuel-canning (PyC-layers) and then eventually enters the primary-circuit of the reactor. ^{90}Sr is a pure beta-ray emitter. A method is discussed which allows the direct quantitative indication of ^{90}Sr from the beta-ray spectrum of the fission products. Three methods can be used for the evaluation of the beta-ray spectra: the Kurie-analysis, the analysis with standard-spectra, and the analysis with an integral-method. The range of application for each of these methods will be explained. A description of the preparation method for the samples and of the measuring apparatus is given. As a beta-ray detector a Si(Li)-semiconductor-detector was used. The thickness of its active volume was 5 mm and its active area was 200 mm^2. An example for the application of these three methods and a comparison of these methods are given. The result of the investigation is the possibility of giving under certain conditions a direct quantitative indication of ^{90}Sr by the analysis of the beta-ray spectrum of a fission-product mixture. (auth)

4991 RELATING THE MASS SPECTRUM TO THE SOLID SAMPLE COMPOSITION. Farrar IV, H. (Atomics International, Canoga Park, CA). pp 239-95 of Trace Analysis by Mass

Spectrometry. /Ahearn, A. J. (ed.). New York; Academic Press, Inc. (1972).

The purpose of the chapter is to examine how and why the recorded mass spectrum can misrepresent the composition of the solid sample and to outline ways of correcting for this misrepresentation so that accurate quantitative determinations of the composition may be obtained. The following topics are discussed: elemental discrimination and its control; relative sensitivity factors; standard samples, including the use of nuclear methods for preparation of special standards; and isotope dilution. (121 references) (J.G.B.)

4992 ANALYSIS OF GASES IN SOLIDS. Roboz, J. pp 369-400 of Trace Analysis by Mass Spectrometry. /Ahearn, A. J. (ed.). New York; Academic Press, Inc. (1972).

The following topics are discussed: standards; vacuum extraction and fusion techniques, including a section on isotope dilution; spark-source technique; ion microprobe mass spectrometry; analysis of lunar samples; conclusions and prognoses. (75 references) (J.G.B.)

4993 DEVICE FOR DETERMINATION OF RADIOACTIVE KRYPTON (^{85}Kr). Lesny, Juraj; Toelgyessy, Juraj (Slovak Technical Univ., Bratislava). Jad. Energ.; 18: No. 12, 410-11 (Dec 1972). (In Czech).

A simple device was constructed for determination of radioactive krypton (^{85}Kr) for preparation of radioactive kryptonates by the diffusion technique. The device is universal and can be used for determination of any radioactive gas. (auth)

4994 RADIOCHEMICAL DETERMINATION OF ^{35}S IN URINE. Hoelgye, Zoltan (Inst. of Industrial Hygiene in Uranium Industry, Pribram, Czech.). Jad. Energ.; 18: No. 12, 407-9(Dec 1972). (In Czech).

A method of determination of ^{35}S in 50 ml. of urine was developed. After mineralizing organic substances in urine with HNO_3 + HCl in the presence of a Cu catalyst, sulfate is precipitated as barium sulfate. In order to remove other radionuclides, barium sulfate is washed with dilute hydrochloric acid and ammonia, and EDTA disodium salt is added for masking. The activity is measured by a low-background measuring device. When using this method, as low an activity as 100 pCi of ^{35}S/50 ml., i.e., 2000 pCi/l. urine, may be reliably determined. Accidental internal contamination corresponding to a dose of the "investigation level" may be detected by this method as long as 95 days after an accident. (auth)

Separation Procedures

Refer also to abstract 5141.

4995 (NBL-265, pp 102-3) ACID DISSOLUTION OF SAMPLES IN MICRO-KJELDAHL FLASKS: A PROGRESS REPORT. Trahey, N. M.; Wenzel, A. W.; Pietri, C. E. Oct 1972. In Annual progress report for the period July 1971-June 1972.

The applicability of micro-Kjeldahl flasks for the nitric acid dissolution of plutonium samples was studied with U_3O_8 as the simulated plutonium material. When the flasks were equipped with condensers to promote refluxing, dissolution was much faster than in open beakers, and less acid was necessary. (auth)

4996 PARTIAL REMOVAL OF HAFNIUM FROM ZIRCONIUM THROUGH THE REACTIONS OF TETRACHLORIDE VAPOURS WITH SOLID SODIUM CHLORIDE. Mazumdar, S.; Ray, H. S. (Indian Inst. of Tech., Kanpur). J. Appl. Chem. Biotechnol.; 22: No. 5, 565-76(May 1972).

A pyrometallurgical method for partial separation of hafnium from zirconium was investigated. The method involves continuous reaction of a flowing gas mixture of zirconium tetrachloride and hafnium tetrachloride with solid sodium chloride in a packed bed reactor. The solid-vapor reaction enriches the vapor phase with respect to zirconium tetrachloride. This may be attributed to a more favorable reaction for hafnium tetrachloride. The influence of a number of parameters, e.g., temperature, gas flow rate, particle size and bed length, was studied. Decreases in flow rate and particle size and increase in bed length are found to favor separation, while temperature has little effect. A simple equation was derived to explain the experimental observations. (auth)

4997 EFFECT OF RESIN CROSS-LINKING ON THE CATION-EXCHANGE SEPARATION OF ALKALI AND ALKALINE EARTH METALS ON SULPHONIC CATION EXCHANGERS. Dybczynski, Rajmund (Inst. of Nuclear Research, Warsaw). J. Chromatogr.; 71: No. 3, 507-22(20 Sep 1972).

The cation-exchange separation of alkali and alkaline earth metal cations was investigated with resins of 2, 8 and 16% nominal cross-linking at various temperatures. Selectivity coefficients, separation factors, plate heights and resolutions of adjacent peaks were calculated from column experiments with loads at the trace level. The best separations of alkali metals and of the Ca-Sr pair were achieved at the highest cross-linking (16%) while the medium cross-linked resin (8%) was the best for the separation of the Sr-Ba pair. It was shown that longitudinal diffusion in the stationary phase contributes significantly to the total plate height. The possibility of predicting the cross-linking at which the minimum value of plate height occurs was demonstrated on the basis of diffusion coefficients, and good agreement with experimental results was obtained. (auth)

4998 EXTRACTION OF HIGHLY OXIDIZABLE ELEMENTS USING A POTENTIOMETRIC METHOD. APPLICATION TO THE EXTRACTION OF Eu(II) USING AN OXINE DERIVATIVE. Leveque, Alain; Rosset, Robert (Ecole Superieure de Physique et Chimie Industrielles, Paris). Analusis; 1: No. 1, 60-5(Apr 1972). (In French).

The solvent extraction of oxidizable metallic cations was effected using a potentiometric titration method. The equation of the potentiometric extraction curve is established for the most general case. This equation gives the formula of the complex extracted in the organic phase and the extraction constant. This method was used for Eu(II) (and Eu^{3+} and Zn^{2+}) extraction. (France)

4999 LIQUID CHROMATOGRAPHY. IV. EFFECTS OF SOLVENT VELOCITY ON SEPARATION USING ION-EXCHANGE RESIN. Morris, B. M. (California State Univ., San Jose); Mode, V. A.; Sisson, D. H. J. Chromatogr.; 71: No. 3, 389-93(20 Sep 1972).

The classical Van Deemter equation has been modified for use in modern high-pressure liquid chromatography. A number of workers have shown that $H = v^n$ accurately describes many separations in liquid-liquid, liquid-solid, and gel permeation chromatography, where $0.2 \leq n \leq 0.6$. The high-pressure ion-exchange separations of the heavy rare earth ions appears to also be described by the exponential equation over a wide range of flow velocities and under a number of different experimental conditions. In this work $n = 0.145 \pm 0.037$ for flow velocities of 0.057 to 3.77 cm/sec. (auth)

5000 TEMPERATURE DEPENDENCE OF DISTRIBUTION COEFFICIENTS OF SOME CATIONS ON A CRYSTALLINE ZIRCONIUM PHOSPHATE OVER THE RANGE 25 TO 80°C. Saito, Yasuhiko; Tomita, Isao (Tokyo Kyoiku Univ.). J. Chromatogr.; 71: No. 3, 538-41(20 Sep 1972).

Mass distribution coefficients are given for Na^+, K^+, Cs^+, Ca^{2+}, Ba^{2+}, Co^{2+}, Zn^{2+}, and Ce^{3+} on a crystalline zirconium phosphate over the range 25 to 80°C. The affinity series are found to be as follows: over the range 25 to 65°C: $Ce^{3+} > Zn^{2+} > Cs^+ > Co^{2+} > K^+ > Ba^{2+} > Ca^{2+} > Na^+$; over the range 65 to 80°C: $Ce^{3+} > Zn^{2+} > Co^{2+} > Cs^+ > K^+ > Ca^{2+}$, $Ba^{2+} > Na^+$. (D.H.M.)

5001 EXTRACTION OF THE PYROPHOSPHATE ACIDOCOMPLEXES OF URANIUM, ZINC, AND RARE EARTH ELEMENTS BY ALKYLAMINES WITHOUT DILUENTS. Shevchuk, I. A.; Tarasenko, L. E.; Chaika, V. D.; Palii, A. I.; Drobysheva, V. P. (Donetsk State Univ., USSR). Ukr. Khim. Zh.; 38: No. 8, 817-18(Aug 1972). (In Russian).

The extraction of pyrophosphate acidocomplexes of U, Zn, and the rare earths was effected with molten fractions of the primary alkylamines C_{17} to C_{20} and with liquid fractions of the primary alkylamines C_{10} to C_{12} without the use of a diluent. The possibility of extracting pyrophosphate complexes of metals by alkylamines in an alkaline medium was demonstrated. (tr-auth)

5002 THIN LAYER CHROMATOGRAPHY OF METAL IONS ON A NEW SYNTHETIC INORGANIC ION-EXCHANGER. Husain, S. Waqif; Kazmi, S. K. (Univ. of Tabriz, Iran). Experientia; 28: No. 8, 988-9(15 Aug 1972).

Studies were made on the chromatographic behavior of 38 metal ions on combined thin layers of stannic arsenate gel and silica gel using 15 buffer solutions. Data are given on separation of V, Ge, Ba, W, Pb, Cd, Cr, Mn, Ag, Ce, Se, Hg, Bi, As, Mo, Sb, and Zn. (M.C.G.)

5003 PREPARATION, PERFORMANCE, AND FACTORS AFFECTING BAND SPREADING OF HIGH EFFICIENCY EXTRACTION CHROMATOGRAPHIC COLUMNS FOR ACTINIDE SEPARATIONS. Horwitz, E. P.; Bloomquist, C. A. A. (Argonne National Lab., IL). J. Inorg. Nucl. Chem.; 34: No. 12, 3851-71(Dec 1972).

High-efficiency extraction chromatographic columns containing bis(2-ethylhexyl) orthophosphate (DEHPA) as the stationary phase and Celite as the inert support were prepared by a slurry packing method. Column performance was studied as a function of particle size of the support, liquid loading of DEHPA, temperature, column cross-sectional area, and bed length by measuring the plate height, H, as a function of mobile phase velocity, v, for the elutions of

Cf(III) and Cm(III). In order to determine the major causes of band spreading for the elution of Cf(III), self-diffusion coefficients of Eu(III) were measured in dilute HNO_3 and undiluted DEHPA as a function of temperature. H vs v data were analyzed in terms of the reduced plate height and velocity. Comparison of calculated and experimental H vs v and H vs capacity factor, k', curves showed that the slow rate of extraction of Cf(III) from the stationary to the mobile phase was the major cause of band spreading at 25°C, whereas, flow phenomena were the major causes of band spreading at 75°C. (auth)

5004 ZIRCONIUM COMPOUNDS AND THEIR EXTRACTION WITH TBP FROM ACID-DEFICIENT SOLUTIONS. Zaitsev, L. M.; Klyuchnikov, V. M.; Apraksin, I. A. Zh. Neorg. Khim.; 17: No. 10, 2761-5(Oct 1972). (In Russian).

The initial compounds manifest in the extraction of Zr and Hf by TBP from acid-deficient solutions are the oxo-chlorides of Zr and Hf, containing α, β, or γ-rings. The type and character of the polymerization of elements in the initial compounds determine the capacity to extract the hydroxynitrates and hyroxythiocyanates of Zr and Hf. There is simultaneously formed in the TBP phase a series of complexes differentiated both as to chemical composition and infrared spectroscopic characterization. (tr-auth)

5005 COORDINATION OF TBP IN THE EXTRACTION OF ZIRCONIUM AND HAFNIUM HYDROXYTHIOCYANATES. Klyuchnikov, V. M.; Zaitsev, L. M.; Voronskaya, G. N.; Apraksin I. A. Zh. Neorg. Khim.; 17: No. 10, 2766-71(Oct 1972). (In Russian).

The extraction of Zr and Hf hydroxythiocyanates by TBP was studied. A series of complexes was formed in the TBP phase in which Zr and Hf were represented as hydrolyzed, polymeric forms. The extraction of the hydroxythiocyanates proceeds with the formation of complexes with the ratio TBP: Zr = 1; the ratio of thiocyanate groups to metal in the extracted compounds varies from 3 to 0.6. (tr-auth)

5006 URANIUM SEPARATION FROM CERTAIN ELEMENTS IN A NITRILOTRIACETIC ACID MEDIUM USING PAPER ELECTROPHORESIS. Marcu, Gheorghe; Tomus, Minerva (Babes-Bolyai Univ., Cluj). Analusis; 1: No. 1, 43-5(Apr 1972). (In French).

A method for rapid separation of the UO_2^{2+} ion from Cs^+, Co^{2+}, Cu^{2+}, Ni^{2+}, Zn^{2+}, MoO_4^{2-} or WO_4^{2-} ions in a nitrilotriacetic medium was developed. This method has various applications in the analysis of uranium ores and fission products and in the obtaining of very pure U sources. (France)

5007 NONEXTRACTABLE COMPOUNDS OF ZIRCONIUM (HAFNIUM) IN SOLUTIONS. Yagodin, G. A.; Kazak, V. G.; Tarasov, V. V. (Moscow Chemical-Technological Inst.). Zh. Neorg. Khim.; 17: No. 9, 2399-2403(Sep 1972). (In Russian).

The chemical behavior of nonextractable (stable multinuclear) Zr(Hf) compounds in nitrate and chloride solutions is discussed. Nonextractable compounds of Zr(Hf) were formed by complex formation with PO_4^{3-}, $C_2O_4^{2-}$, SO_4^{2-}, $S_2O_3^{2-}$, citrate, tartrate, EDTA, and ZrF_8^{3-}. The precipitation of Zr in a nonextractable form from HNO_3 solutions by sulfate ion, for example, depended on the molar ratio SO_4^{2-}: Zr, which was required to be about 1: 4 or higher for precipitation to occur, and to attain values of about 2: 3 for precipitation to be complete. The fundamental structural unit of such compounds is the tetrameric cation. (K.S.W.)

5008 EXTRACTION OF URANIUM(VI) FROM HYDROCHLORIC ACID SOLUTIONS BY LONG-CHAIN ALKYL QUATERNARY AMMONIUM CHLORIDE. Sato, T. (Shizuoka Univ., Hamamatsu, Japan). J. Inorg. Nucl. Chem.; 34: No. 12, 3835-43 (Dec 1972).

The partition of uranium(VI) between hydrochloric acid solutions and organic solutions of a quaternary ammonium chloride was investigated under different conditions. The absorption spectra of both the aqueous and organic phases were examined, and the ir and high-resolution NMR spectra of the organic phase were studied. (auth)

5009 SEPARATION OF PROTACTINIUM(V) FROM PROTACTINIUM(IV) BY EXTRACTION WITH TRI-N-OCTYLAMINE FROM THIOCYANATE SOLUTIONS. Pal'shin, E. S.; Nekrasova, V. V.; Myasoedov, B. F. Zh. Anal. Khim.; 27: No. 8, 1626-9(Aug 1972). (In Russian).

The extraction of Pa(V) and Pa(IV) traces with solutions of tri-n-octylamine in xylene from thiocyanic acid solutions was studied. Conditions for effective separation of Pa(V) from Pa(IV) were found. (auth)

5010 STABILITY AND EXTRACTION OF HALIDE COMPLEXES OF METALS (A REVIEW). Spivakov, B. Ya.; Petrukhin, O. M.; Zolotov, Yu. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 27: No. 8, 1584-97(Aug 1972). (In Russian).

Stability constants and some other parameters, characterizing stability of halide complexes of metals in aqueous solutions, were compiled. The dependence of solvent extraction of halide complexes on their stability was considered. Stability constants together with other characteristics of the extraction system allow to calculate extraction constants for neutral not solvated metal halides, complex acids and salts with bulky organic cations. Data on stability of complexes make it possible to compare the extraction behavior of neutral not solvated metal halides and complex acids formed by class "b" metals. The stability of the complex anion is a main factor responsible for different extraction of ions of any class if bulky cations are used as extractants for complex anions. It is more difficult to use the stability constants for the comparison of the extraction of metal halides extracted as coordinatively solvated salts. (auth)

5011 SEPARATION CHEMISTRY OF THE LANTHANIDES AND TRANSPLUTONIUM ACTINIDES. Hulet, E. K.; Bode, D. D. (Univ. of California, Livermore). pp 1-45 of Lanthanides and Actinides. /Bagnall, K. W. (ed.). Baltimore; University Park Press (1972).

The separation of the trivalent lanthanides and actinides by ion-exchange chromatography, solvent extraction, and extraction chromatography is reviewed. Separations based on oxidation and reduction as applied to dipositive lanthanides and actinides and Ce(IV), Bk(IV), and Am(V and VI) are also discussed. Details of selected large-scale processes for rare earth processing, recovery of transplutonium elements, and recovery of transplutonium elements from underground nuclear explosions are given. (208 references) (J.G.B.)

5012 COMPLEXES OF THE LANTHANIDES. Moeller, Therald (Arizona State Univ., Tempe). pp 275-98 of Lanthanides and Actinides. /Bagnall, K. W. (ed.). Baltimore; University Park Press (1972).

Complexes of the lanthanides are reviewed from the standpoint of coordination number and molecular geometry, thermodynamic stability in solution, kinetics and complexation, bonding in complex species, complexes in separations, and emission of radiant energy. (175 references) (J.G.B.)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 5151, 5154, 5155, 5617, 6825, and 6888.

5013 (ORNL-4782, pp 44-107) CHEMISTRY. Oct 1972. In Molten-Salt Reactor Program.

BERYLLIUM FLUORIDES — BeF_2–NaF, electrical conductance in, p. 98
— alkali metal fluoride–BeF_2, electrochemical mass transport in molten, p. 96-8
BERYLLIUM OXIDES — BeO–NiO–Nb_2O_5, equilibration in molten lithium beryllium fluoride, p. 89-91
BISMUTH — electrochemical studies of trivalent, in molten beryllium fluoride–lithium fluoride–zirconium fluoride at 500°C, p. 82
BORON FLUORIDES — solubility in fluoride metals, research progress on, p. 63-5
CESIUM BERYLLIUM FLUORIDES — Cs_2BeF_4–CsI, phase diagrams for, p. 106-7
CHROMIUM — reduction of trivalent, in molten sodium fluoroborate–sodium fluoride, voltammetric study of, p. 82-3
FISSION PRODUCTS — deposition of noble metal, from MSR, factors affecting, p. 45-50
FUSED SALTS — spectral studies of, p. 84-6
— spectra of, apparatus for ir, p. 59
GRAPHITE — fission product deposition on surveillance specimens from final core specimen array in MSRE, p. 45-50
HASTELLOY N — fission product deposition on surveillance specimens from final core specimen array in MSRE, p. 45-50
— corrosion in MSR fuel system, effects of fission products on, p. 50-1
— corrosion by fluoroborates, relationship of free energy of formation of sodium iron fluoride and sodium nickel fluoride to, p. 65-8
HELIUM — solubility in lithium beryllium fluoride at 600°C, p. 53
HYDROGEN — solubility in lithium beryllium fluoride at 600°C, p. 53

—permeation through metals at low pressure, p. 56-7
—permeation through metals, effects of films or coatings on rate of, p. 56-7
—evolution from molten fluoroborates, p. 57-9
—hydrolysis and voltammetric studies of, in molten sodium fluoroborates, p. 83
—determination in sodium fluoroborate–sodium fluoride salts, p. 83-4
LITHIUM BERYLLIUM FLUORIDES—Li_2BeF_4–LiI, phase diagrams for, p. 106-7
LITHIUM FLUORIDES—BeF_2–LiF, thermodynamics of mixtures of, p. 95-6
LITHIUM SODIUM BERYLLIUM FLUORIDE—spectra of polycrystalline $Na_2LiBe_2F_7$, Raman, p. 100-3
MOLTEN SALT BREEDER REACTOR—chemistry studies for, progress in
NICKEL—corrosion in MSR fuel system, effects of fission products on, p. 50-1
NIOBIUM—chemistry in molten fluorides, p. 87-91
—reactions with molybdenum hexafluoride vapor, p. 91-5
NIOBIUM OXIDES—BeO–Nb_2O_5, equilibration with molten beryllium fluoride–lithium mixtures, p. 87-9
PLUTONIUM OXIDES—PuO_2–ThO_2, exchange equilibria with molten salt reactor fluorides, p. 72-4
POTASSIUM CHROMATES—spectra of molten and crystallin $K_2Cr_2O_7$, Raman, p. 103-6
POTASSIUM NITRATES—thermal stability of, p. 62
PROTACTINIUM—separation from MSBR fuel salt by oxide precipitation, p. 70-2
PROTACTINIUM OXIDES—PaO_2–ThO_2, exchange equilibria with molten salt reactor fluorides, p. 72-4
—PaO_2–ThO_2–UO_2, activity coefficients in solid solution of, p. 74-6
SODIUM BERYLLIUM FLUORIDES—Na_2BeF_4–NaI, phase diagrams for, p. 106-7
SODIUM FLUORIDES—$NaBF_4$–NaF, chemical behavior of BF_3OH^- and BF_3OD^- ions in molten, ir spectral studies of, p. 59-62
SODIUM FLUOROBORATES—preparation of fused, for coolant salt for MSBR, p. 68-9
SODIUM NITRATES—thermal stability of, p. 62
SODIUM NITRITES—thermal stability of, p. 62
STAINLESS STEEL—corrosion of Type 3041, in MSR fuel system, effects of fission products on, p. 50-1
TELLURIUM—reactions with cobalt fluoride
TITANIUM—oxidation of trivalent, in molten beryllium fluoride–lithium fluoride–zirconium fluoride, voltammetric studies of, p. 81-2
TRITIUM—chemistry in core of molten salt reactor, initial, p. 53-4
—permeation through metals, p. 56-7
URANIUM—determination of trivalent, in beryllium fluoride–lithium fluoride–uranium tetrafluoride–zirconium fluoride salt, development of in-line, p. 77-90
URANIUM FLUORIDES UF_3—disproportionation equilibrium for beryllium fluoride–lithium fluoride mixtures in graphite, p. 98-100
URANIUM OXIDES UO_2—ThO_2–UO_2, exchange equilibria with molten salt reactor fluorides, p. 72-4 (D.H.M.)

5014 HYDROGENATION OF Hf. Caillet, Marcel; Vigneron, Jacques; Besson, Jean (Ecole National Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France). Bull. Soc. Chim. Fr.; No. 8, 3041-5(Aug 1972). (In French).

Investigations of the thermogravimetric behavior of the reaction between hydrogen and hafnium between 900 and 1000°C at pressures between 10 and 350 torr established the existence of a preliminary parabolic stage during which a small quantity of unknown sub-hydride HfH_x was produced together with the dissolution of hydrogen in the metal. A second linear stage (independent of the pressure) was observed to correspond to the formation of two known hydrides: $HfH_{1.70}$ and $HfH_{1.98}$. This process is most probably due to a decomposition reaction occurring in the solid phase with the sub-hydride. (France)

5015 PREPARATION, COMPOSITION, AND SOME PHYSICOCHEMICAL PROPERTIES OF THE LANTHANIDE COMPLEXES WITH THENOYLTRIFLUOROACETONE. Lis, S.; Siekierski, S. (Inst. of Nuclear Research, Warsaw). Chem. Anal. (Warsaw); 17: No. 4, 979-87(1972).

Complexes of all lanthanides (excluding Pm) with thenoyltrifluoroacetone (TTA) of a general formula $Ln(TTA)_3 \cdot nH_2O$ were prepared. The results of elemental analysis and of titration with K. Fischer reagent showed a different degree of hydration from La to Lu. The dehydration process, its reversibility and the thermal behavior of these compounds were studied. The different degrees of hydration of the complexes determines their behavior in the course of thermogravimetric analysis and dehydration-hydration experiments. The solubility of hydrated complexes was determined in carbon tetrachloride and benzene, that of dehydrated complexes in carbon tetrachloride and hexane. In the case of the solubility of hydrated complexes in CCl_4 the points appear to lie on a parabola with a minimum at Gd. The solubility of dehydrated complexes in CCl_4 increased more or less monotonically with Z. The ir spectra of the solid compounds in the 3000 to 3800 cm^{-1} range show that hydrogen bonding is present in these complexes. (auth)

5016 NUCLEAR WATER CHEMISTRY. Lux, J. A.; Hicks, J. A. 11p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

The Nuclear Steam Supply System supplied by the Babcock and Wilcox Company is described. This system consists of a reactor vessel, pressurizing equipment, vapor generators producing vapor for the turbogenerator, and centrifuge pumps for circulating the reactor cooling fluid in the vapor generators. An original once-through vapor generator is described. The principal chemical aspects of the study of the reactor coolant relate to the choice of pH additives, corrosion and hydride formation with zircaloy, analysis of the water and the operation of the system, and the purification of the coolant by demineralization. (France)

5017 CHEMISTRY OF WATER AND SOLUTIONS AT HIGH TEMPERATURES FOR APPLICATION TO CORROSION IN POWER SYSTEMS. Cohen, P. 107p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

The corrosion of the materials used in conventional or nuclear vapor generators in the different aqueous media employed was studied. The thermodynamic properties and the structure of the water and ionic solutions are reviewed. Particular emphasis is given to NH_4OH, LiOH, NaOH, boric acid, sulfates, phosphates, halides, the hydroxides of alkaline earths, and Fe_3O_4. The composition of the coolant fluid of pressurized water reactors is discussed. Sodium phosphate and sulfate are used in vapor generators. The hydrolytic reactions occurring with the contaminants in high-pressure boilers were studied. The heat transfer, mass transfer, and radiolysis in vapor generators were studied together with the effect of the deposits on the heat exchanger surface. (France)

Isotope Effects

Refer also to abstract 5086.

5018 (COO–3313-1) KINETIC HYDROGEN ISOTOPE EFFECTS ON THE RATES OF IONIZATION OF SOME ACETYLTHIOPHENES AND ACETYLPYRIDINES. Progress Report, February 1, 1972–October 25, 1972. Hetzer, T. B.; Smucker, L. D.; SubbaRao, S. C. (Lincoln Univ., Pa. (USA)). 1972. Contract AT(11-1)-3313. 3p. Dep. NTIS.

Values are presented for the isotope effects on the rate of ionization of 2-acetylthiophene (19.8), 2-acetylpyridine (25.5), and 3-acetylpyridine (30.8). (D.H.M.)

5019 ISOTOPE EFFECTS IN ASSOCIATIVE IONIZATION PROCESSES. Kupriyanov, S. E. High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 93-5(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 107-9(1972).

The processes of formation of the complex ions HeH_2^+, HeD_2^+, $ArC_2H_2^+$, $ArC_2D_2^+$, $ArC_2H_4^+$, and $ArC_2D_4^+$ during collisions of metastable helium and argon atoms with molecules of hydrogen, acetylene, ethylene, and their deutero analogues, were investigated. The relative probabilities of formation of the complex ions are much greater if hydrogen atoms rather than deuterium atoms enter into their composition. An explanation of this phenomenon is suggested. (auth)

5020 ^{13}CO SUBSTITUTION IN $Mn_2(CO)_{10}$ AND $Re_2(CO)_{10}$. Wozniak, W. T.; Sheline, R. K. (Florida State Univ., Tallahassee). J. Inorg. Nucl. Chem.; 34: No. 12, 3765-9(Dec 1972).

By means of ^{13}CO-enriched $Mn(CO)_5Br$ and ^{13}CO-enriched $Re(CO)_5Cl$, isotopically enriched species of $Mn_2(CO)_{10}$ and $Re_2(CO)_{10}$ were prepared. Infrared and Raman spectra in the CO-stretching region were obtained for these molecules and detailed assignments of the CO-stretching modes were made. Force constants were calculated using a CO-factored force field. The results indicate

that some of the assumptions of the Cotton–Kraihanzel (J. Am. Chem. Soc.; 84: 4432(1962)) force field are valid for these compounds. (auth)

5021 MECHANISM AND RELATIVE CROSS SECTIONS OF SOME ION–MOLECULE REACTIONS AT SMALL COLLISION ENERGIES. Sumin, L. V. (Inst. of Mineral Reserves, Moscow). Dokl. Akad. Nauk SSSR; 200: No. 4, 893-6(1 Oct 1972). (In Russian).

The relative dependence of the cross sections of ion–molecule reactions on the kinetic energy of the colliding particles was studied with a mass spectrometer. The particles were continuously accelerated up to energies ≤3 eV. Of the eight reactions investigated, two involved the ionized hydrogen molecule: $H_2^+ + H_2 \rightarrow H_3^+ + H$, and $H_2^+ + He \rightarrow HeH^+ + H$; one involved D_2O: $D_2O^+ + D_2O \rightarrow D_3O^+ + OD$; and the remaining five reactions implicated CH_4, NH_3, C_2H_4, and CH_3OH or their deuterated forms. (K.S.W.)

5022 KINETIC ISOTOPE EFFECT IN THE DEHYDROGENATION OF CYCLOHEXANE ON CHROMIUM OXIDE. Gadzhi-Kasumov, V. S.; Kiperman, S. L.; Isagulyants, G. V. (Inst. of Organic Chemistry, Moscow). Kinet. Katal.; 13: No. 2, 515-16 (1972). (In Russian).

The kinetics of the two reactions: $C_6H_{12} = C_6H_6 + 3H_2$; and $C_6D_{12} = C_6H_6 + 3D_2$ were measured and compared, using ignited CrO_3 catalyst in both cases. The isotope effect, $\beta = 2.0$ to 2.1, where $\beta = k_H/k_D$, the ratio of the respective reaction rate constants. (K.S.W.)

5023 VIBRATIONAL ANALYSES OF N-SUBSTITUTED AZIRIDINES. III. 1-AZIRIDINYL CARBOXAMIDE-d_0 AND -N,N-d_2. Spell, H. L.; Laane, J. (Texas A and M Univ., College Station). J. Mol. Struct.; 14: No. 1, 39-52(Oct 1972).

The infrared, far-infrared, and Raman spectra of 1-aziridinyl carboxamide-d_0 and -N,N-d_2 were recorded and analyzed. The spectra are consistent with a C_s structure in which the $C-C(O)NH_2$ framework is planar. The spectra of these molecules parallel those of previously studied aziridines in that many of the CH_2 and ring vibrations are relatively unshifted from molecule to molecule. (auth)

5024 MOLECULAR CONSTANTS OF SUBSTITUTED ETHYLENE-TYPE MOLECULES. IV. INERTIA DEFECTS AND ROTATIONAL CONSTANTS OF VINYL HALIDES AND THEIR DEUTERATED DERIVATIVES. Jeyapandian, S.; Savari Raj, G. A. (Univ. of Madras). J. Mol. Struct.; 14: No. 1, 27-37(Oct 1972).

The inertia defects of some vinyl halides and their deuterated derivatives were calculated on the basis of the general formulation developed by Oka and Morino. The initial sets of Urey–Bradley force constants, based on published data, were adjusted by a least squares procedure until they reproduced the fundamental vibrational frequencies satisfactorily. The Coriolis coupling constants which satisfy the sum rules derived were evaluated and used to calculate the inertia defect in the ground vibrational state. The theoretical values of the inertia defect are used to determine the rotational constant A which cannot otherwise be accurately determined from an "a" type transition. (auth)

5025 MOLECULAR CONSTANTS OF SUBSTITUTED ETHYLENE-TYPE MOLECULES. III. CORIOLIS COUPLING CONSTANTS AND INERTIA DEFECTS OF CIS- AND TRANS-1,2-DICHLOROETHYLENE. Jeyapandian, S.; Savari Raj, G. A. (Univ. of Madras). J. Mol. Struct.; 14: No. 1, 17-25(Oct 1972).

The inertia defects of the cis- and trans-1,2-dichloroethylene and their deuterated modifications are evaluated on the basis of the general formulation developed by Oka and Morino. The Urey–Bradley force constants which reproduce the observed vibrational frequencies are calculated and used to obtain the F matrix and the Coriolis coupling constants. The Coriolis coupling constants, which satisfy the sum rules derived, are used to evaluate the inertia defect in the ground vibrational state. On the basis of this calculation, and other evidence, the cis-1,2-dichloroethylene is shown to have a planar structure. (auth)

5026 MODEL CALCULATIONS OF SECONDARY α-DEUTERIUM ISOTOPE EFFECTS IN ADDITION REACTIONS TO OLEFINIC DOUBLE BONDS. Safarik, I.; Strausz, O. O. (Univ. of Alberta, Edmonton). J. Phys. Chem.; 76: No. 24, 3613-17(23 Nov 1972).

In detailed calculations within the framework of transition state theory it is shown that in the addition of methyl or trifluoromethyl radicals to ethylene, as in the previously reported $S(^3P)$ + ethylene system, the main single contributing factor to secondary α-H/D isotope effects is, contrary to earlier notions, not the rehybridization of the carbon atoms but the creation of new normal modes during the reaction. Although calculations thus far have been carried out only for three systems, the effect is clearly independent of the nature of the reagents and in general it may be stated that at least one of the newly created vibrations will be isotopically sensitive and generate a secondary α-H/D kinetic isotope effect larger in magnitude than that generated by the rehybridization of the carbon atoms. (auth)

5027 VARIATION OF Cl QUADRUPOLE COUPLING WITH ISOTOPIC SUBSTITUTION IN CH_3Cl. Kukolich, S. G.; Nelson, A. C. (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys.; 57: No. 9, 4052-4(1 Nov 1972).

Changes in the chemical properties of the methyl group on deuterium substitution are revealed by high-resolution microwave measurements of Cl quadrupole coupling. There was a decrease of 0.2% in the electric field gradient at the chlorine nucleus. There was a direct effect due to the increased mass of the methyl group. The most important mechanism appeared to be an indirect effect involving changes in the chemical properties of the methyl group. (M.C.G.)

5028 CASCADE DEACTIVATION AND PRESSURE DEPENDENT NONEQUILIBRIUM KINETIC ISOTOPE EFFECTS FOR CHEMICALLY ACTIVATED DICHLOROETHANE-d_0 AND -d_4 MOLECULES. Setser, D. W.; Siefert, E. E. (Kansas State Univ., Manhattan). J. Chem. Phys.; 57: No. 9, 3613-22(1 Nov 1972).

The competition between unimolecular dehydrohalogenation and collisional deactivation of chemically activated 1,2-$C_2H_4Cl_2$, $\langle E \rangle$ = 88.3 kcal mol^{-1}, and 1,2-$C_2D_4Cl_2$, $\langle E \rangle$ = 89.3 kcal mol^{-1}, formed by combination of CH_2Cl and CD_2Cl radicals at 300°K was investigated in various bath gases. For each gas, the kinetic isotope effect, $k_a(H)/k_a(D)$, was measured over a wide pressure range. Within experimental error, all gases gave the same isotope effect at high pressure; $k_a^\infty(H)/k_a^\infty(D) = 3.2 \pm 0.2$. At lower pressures the isotope effect markedly increased and for the lowest pressures the rate constant ratio was ~8. Cascade vibration deactivation is shown to be the source of the pressure dependence of the kinetic isotope effect. The cascade deactivation of C_2H_4Cl and $C_2D_4Cl_2$ by $CH_3Cl(CD_3Cl)$ and CO was adequately described by a stepladder model with average energy losses per collision of 6 and 4 kcal mol^{-1}. For Ne and He bath gases, an exponential model with average energy losses of 2.9 and 1.4 kcal mol^{-1} was satisfactory. There was no specific isotope effect on the collisional transition probabilities for $C_2H_4Cl_2$ and $C_2D_4Cl_2$. (auth)

5029 GAS-PHASE ELECTRON PARAMAGNETIC RESONANCE ABSORPTION IN A $N^{16}O$, $N^{17}O$, AND $N^{18}O$ MIXTURE. Ashford, N. A.; Jarke, F. H.; Solomon, I. J. (Illinois Inst. of Tech., Chicago). J. Chem. Phys.; 57: No. 9, 3867-70(1 Nov 1972).

The X-band EPR spectra of a gaseous mixture of $^{14}N^{16}O$, $^{14}N^{17}O$, and $^{14}N^{18}O$ are presented. Statistically significant differences in the spectra indicate that a unified theory of isotopic effects is derivable from the data. The oxygen-17 hyperfine interaction was found to be ≈57.4 G and a large oxygen-17 quadrupole interaction is indicated. The s character of the $2p\pi$ electron on oxygen in nitric oxide is estimated to be 2.0%, in good agreement with that estimated for the isoelectronic molecule $^{17}O_2^-$. (auth)

5030 ISOTOPIC SHIFT FOR LARGE-AMPLITUDE VIBRATIONS. Redding, R. W. (North Texas State Univ., Denton). J. Chem. Phys.; 57: No. 9, 3729-31(1 Nov 1972).

The isotopic frequency ratio ν_H/ν_D was calculated for a linear molecular model O–H–O where the hydrogen atom moves in a double-minimum potential. The results show that the isotopic ratio deviates considerably from the harmonic value but never becomes less than unity. (auth)

5031 VIBRATIONAL ANALYSES AND BARRIER TO INTERNAL ROTATION OF 1,1-DICHLOROETHANE AND 1,1-DICHLOROETHANE-d_4. Durig, J. R.; Sloan, A. E.; Will, J. D. (Univ. of South Carolina, Columbia). J. Phys. Chem.; 76: No. 24, 3591-7(23 Nov 1972).

The infrared spectra of gaseous and solid 1,1-dichloroethane and 1,1-dichloroethane-d_4 were recorded from 140 to 4000 cm^{-1}. The corresponding Raman spectra of the gases and liquids were also recorded and depolarization values were measured. All spectra were interpreted in detail and the 18 normal vibrations were characterized on the basis of the band contours, isotopic shifts, depolarization values, and normal coordinate calculations. The internal torsional mode was observed at 196 cm^{-1} in the infrared spectrum of solid CD_3CDCl_2. The threefold barrier to rotation was calculated to be 4.77 kcal/mol. This value is compared to those reported for other chloroethanes. (auth)

5032 ISOTOPE SOLVENT EFFECT ON TRIPLET STATE OF XANTHENE DYES IN H_2SO_4 AND D_2SO_4 SOLUTIONS. Pant, D. D.; Pant, K. C.; Joshi, N. B. (D.S.B. Government Coll.,

Naini Tal, India). Curr. Sci. (India); 41: No. 22, 807-8(20 Nov 1972).

Deuterium solvent effect was studied for xanthene dyes using concentration $\approx 5 \times 10^{-5}$ M in H_2SO_4 and D_2SO_4 as solvent. It is observed that both triplet decay time and the ratio of phosphorescence to fluorescence emission yield increase in solvent D_2SO_4 as compared to H_2SO_4 for the dyes. (auth)

5033 COMPUTED BOND ENERGIES AND VIBRATIONAL FREQUENCIES FOR ClHCl, BrHBr, AND IHI, INCLUDING ISOTOPE EFFECTS AND ANHARMONICITY. Truhlar, D. G. (Univ. of Minnesota, Minneapolis); Olson, P. C.; Parr, C. A. J. Chem. Phys.; 57: No. 10, 4479-83(15 Nov 1972).

The bond-energy–bond-order (BEBO) method of Johnston and Parr predicts ClHCl, BrHBr, and IHI are all bound and symmetric. When corrected for anharmonicity of the asymmetric stretch normal mode, it predicts the following vibrational frequencies in cm^{-1} (experimental results are in parentheses; s is the symmetric stretch and a is the asymmetric stretch): ClHCl, s: 371 (259); ClDCl, s: 370 (265), a: 318 (463); BrHBr, s: 222 (165), a: 533 (727); BrDBr, s: 222 (170), 442 (496); IHI, s: 165 (121), a: 862 (686); IDI, s: 165 (124), a: 677 (470). The predictions of the London–Eyring–Polanyi–Sato (LEPS) method for vibration frequencies are presented but are in much worse agreement with experiment. The BEBO method predicts the following depths of the potential energy minima (in kcal/mole) and equilibrium bond distances (in 10^{-8} cm), respectively: ClHCl, 1.56, 1.45; BrHBr, 3.02, 1.60; IHI, 6.77, 1.79. (auth)

5034 VIBRATIONAL SPECTRUM OF METHANETELLUROL. Sink, C. W.; Harvey, A. B. (Naval Research Lab., Washington, DC). J. Chem. Phys.; 57: No. 10, 4434-42(15 Nov 1972).

The infrared and Raman spectra of methanetellurol were investigated with the aid of the isotopic species CH_3TeD, CD_3TeH, CD_3TeD. Spectra of vapor, liquid, and matrix isolated samples are presented. The spectra of the molecule are consistent with the expected C_s symmetry and resemble those of a near symmetric top molecule. Normal coordinate calculations were conducted and results are reported and compared with similar molecules. Unfortunately, repeated attempts to observe the torsional motion in both solid matrix and vapor were unsuccessful. (auth)

5035 VELOCITY OF SOUND IN LITHIUM–ND_3 SOLUTIONS. Franceware, L. B.; Priesand, M. A.; Bowen, D. E. (Univ. of Texas, El Paso). J. Chem. Phys.; 57: No. 10, 4099-4100 (15 Nov 1972).

The velocity of 10 MHz compressional waves in solutions of lithium in liquid ND_3 are reported. These data are quite similar to the earlier data in Li–NH_3 solutions with the Li–ND_3 sound velocity being lower than that in the Li–NH_3 solutions. Data for pure liquid ND_3 is also reported. (auth)

5036 DENSITY AND VISCOSITY OF LIQUID ND_3. Alei, M. Jr. (Los Alamos Scientific Lab., NM); Litchman, W. M. J. Chem. Phys.; 57: No. 10, 4106-10(15 Nov 1972).

The density and viscosity of liquid ND_3 were measured over the temperature range from +30°C to −25°C and compared with the density and viscosity of liquid NH_3. At any given temperature, the ratio of densities ρ_{ND_3}/ρ_{NH_3} is 1.187 ± 0.001 and the ratio of viscosities η_{ND_3}/η_{NH_3} is 1.20 ± 0.01. The fact that both ratios are independent of temperature suggests that the strengths of intermolecular interactions are essentially the same in the two liquids and that the density and viscosity differences are to be attributed to differences in molecular size and mass. The density ratio indicates that the molecular volume of NH_3 in the liquid is ~1% larger than that of ND_3 while the viscosity ratio indicates that the viscosity varies directly as M/V_m (V_m = molar volume) for these two liquids. (auth)

5037 LASER RAMAN SPECTRUM OF CRYSTALLINE CYCLOPENTANE-d_0 AND -d_{10}. Schettino, V.; Marzocchi, M. P. (Univ., Florence). J. Chem. Phys.; 57: No. 10, 4225-9(15 Nov 1972).

The laser Raman spectrum of the crystal form III of cyclopentane and cyclopentane-d_{10} was measured at 85°K. The frequencies and splittings of the internal modes and the number of observed lattice modes are consistent with the crystal structure deduced from the analysis of the infrared spectrum. Some details of the vibrational assignment are discussed, and consistency with observed gas phase heat capacities is checked. (auth)

5038 CENTRIFUGAL DISTORTION ANALYSIS OF HYPOFLUOROUS ACID: HOF AND DOF. Pearson, E. F. (Southern Illinois Univ., Carbondale); Kim, H. J. Chem. Phys.; 57: No. 10, 4230-3(15 Nov 1972).

The millimeter wave rotational spectrum of hypofluorous acid displays sizeable distortion effects. More than forty lines each for both HOF and DOF including a- and b-type transitions were measured. A semirigid rotor Hamiltonian, which includes the quartic distortion terms, was employed to fit the spectrum. The special constants (in MHz) in the notation of Watson are for HOF: $\tilde{A}$ = 585 631.20, $\tilde{B}$ = 26 760.31, $\tilde{C}$ = 25 510.19, Δ_J = 0.09414, Δ_{JK} = 2.4146, Δ_K = 82.52, δ_J = 0.00432 and δ_K = 1.120. For DOF: $\tilde{A}$ = 316 096.02, $\tilde{B}$ = 25 593.91, $\tilde{C}$ = 23 585.28, Δ_J = 0.07903, Δ_{JK} = 1.7349, Δ_K = 24.82, δ_J = 0.005933 and δ_K = 1.183. Corrections to $\tilde{A}$, $\tilde{B}$, and $\tilde{C}$ given above were applied to obtain the effective moments of inertia, and the structure is recalculated. (auth)

5039 EXCHANGE IN HYDROGEN–DEUTERIUM ADSORBED ON NICKEL. Boreskov, G. K.; Savchenko, V. I. (Inst. of Catalysis, Novosibirsk, USSR). Kinet. Katal.; 13: No. 1, 109-14 (1972). (In Russian).

The hetero-exchange of hydrogen/deuterium in the gaseous phase when adsorbed on Ni was studied. The characteristic curve is described as $C_{D_2} = f(\tau)$, suggesting that exchange on Ni at 273°C proceeds according to an adsorption-desorption mechanism. (tr-auth).

5040 ANOMALOUS KINETIC KYDROGEN ISOTOPE EFFECTS ON THE RATE OF IONIZATION OF SOME DIALKYL SUBSTITUTED KETONES. Lynch, R. A.; Vincenti, S. P.; Lin, Y. T.; Smucker, L. D.; Subba Rao, S. C. (Lincoln Univ., PA). J. Amer. Chem. Soc.; 94: No. 24, 8351-6(29 Nov 1972).

The rates of hydroxide-catalyzed H^+, D^+, and T^+ transfer from 2,4-dimethyl-3-pentanone and 3,5-dimethyl-4-heptanone were measured over a temperature range. The Arrhenius plots are linear and the deuterium isotope effects are normal. These results suggest that tunneling is not significant in these reactions. The rates of H^+ and T^+ transfers are similar and apparently there is no tritium isotope effect. The results suggest that in detritiation, T^+ transfer is not the rate determining step. A mechanism for tritium–hydrogen exchange is proposed. (auth)

5041 SOLVENT STERIC EFFECTS. III. MOLECULAR AND CRYSTAL STRUCTURES OF AZOBISISOBUTYRONITRILE AND AZOBIS-3-CYANO-3-PENTANE. A STRUCTURAL DEUTERIUM ISOTOPE EFFECT. Jaffe, A. B.; Malament, D. S.; Slisz, E. P.; McBride, J. M. (Yale Univ., New Haven). J. Amer. Chem. Soc.; 94: No. 24, 8515-21(29 Nov 1972).

Lattice parameters were determined for normal and perdeuterated azobisisobutyronitrile (AIBN) in $P\bar{1}$ and $P2_1/c$ modifications and showed significant variation with isotopic substitution. Three dimensional intensity data were collected by diffractometer for three of these crystals and for a crystal of azobis-3-cyano-3-pentane (ACP) and all were refined to conventional R's of 0.05 to 0.09. The refinement of ACP was in space group Cmca (Z = 4) and gave a long C–C bond, a wide C–C–C angle, and unrealistic thermal parameters suggesting disorder with respect to the mirror plane, which was confirmed by observation of diffuse scattering. Otherwise bond lengths and angles are consistent among the determinations and with those of other azoalkanes. The nitrile and azo groups are nearly eclipsed to give planar, S-shaped N≡CCN=NCC≡N backbones for molecules in these crystals. The backbones are arranged into sheets containing a herringbone pattern of nitrile groups. The photochemistry of crystalline AIBN and ACP is discussed in terms of these packings, and it was concluded that dipolar forces are probably predominant in product determination. An approach to computer simulation of radical reactions in crystalline matrices is mentioned. The thermal transformation of $P2_1/c$ AIBN to P1 AIBN is not consistently topotactic. (auth)

5042 BARRIERS TO ROTATION ABOUT C–N BONDS. I. ROTATION ABOUT THE C–N BOND IN MONO-, DI- AND TRIFLUOROACETAMIDE, AND DEUTERIUM ISOTOPE EFFECTS UPON ^{19}F SHIELDING. Pendlebury, M. H.; Phillips, L. (Imperial Coll. of Science and Tech., London). Org. Magn. Resonance; 4: No. 4, 529-35(Aug 1972).

The ^{19}F NMR spectra of mono- and difluoroacetamide are used to derive the activation parameters for rotation about the C–N bond; it is not possible to obtain useful results for trifluoroacetamide. A total line shape analysis is used. Unusually large deuterium isotope effects upon the shielding of the ^{19}F nucleus are observed for N-deuterated derivatives. The magnitude of the isotope effect is different for mono-, di- and trifluoroacetamides, and in the mono-deuterated species the isotope effect is different for cis and trans rotational isomers. (auth)

Isotope Exchange and Isotope Separation

5043 (GAT–674) URANIUM ISOTOPE SEPARATION BY CHEMICAL EXCHANGE REACTIONS BETWEEN UF_6 AND DERIVATIVES OF UF_6–NITROGEN OXIDE COMPLEXES. Saraceno, A. J.; Trivisonno, C. F. (comps. and eds.) (Goodyear Atomic Corp., Piketon, Ohio). 4 Feb 1972. Contract AT(33-2)-1. 11p. Dep. NTIS.

Chemical exchange reactions for the separation of the principal uranium isotopes were investigated for systems consisting of uranium hexafluoride and nitrogen oxide-derived complexes of uranium hexafluoride. The equation representing the chemical equilibrium is: $^{238}UF_6 + NO^{235}UF_6 \rightleftharpoons {}^{235}UF_6 + NO^{238}UF_6$, with the ^{235}U enrichment occurring in the UF_6 phase when UF_6 gas was contacted with solid $NOUF_6$. Single stage separation factors of 1.0016 at 25°C and 1.0011 at 70°C were observed. Similar results were obtained using $NOUF_7$ and NO_2UF_7 in place of $NOUF_6$. These exchange reactions were found to be impractically slow, but when they were catalyzed by HF, equilibrium time was reduced from about 100 hours to less than 2 hours. This led to an approach based on contacting two-phase immiscible solvent systems. The most promising system consisted of $NOUF_6$ dissolved in HF, a polar ionizing solvent that catalyzes the exchange, and UF_6 dissolved in Freon-114 ($C_2F_4Cl_2$). This system yielded a $^{235}U/^{238}U$ single stage separation factor of 1.0016 at 25°C after one hour of contact time. ^{235}U enrichment was always observed in the heavier (Freon-114) UF_6-containing phase. The system was investigated further in a column-type operation to determine how well it might operate in a large scale operation. This work was discontinued when difficulties were encountered in adapting the system to multi-stage operation or cascading. No efficient economic means could be found for interconverting $NOUF_6$ and UF_6 in their respective solvents and the work was discontinued. This report summarizes the progress reports of P. R. Ogle, who performed the work during the period of October 1961 to December 1964. (auth)

5044 HYDROGEN EXCHANGE. Englander, S. W.; Downer, N. W.; Teitelbaum, H. (Univ. of Pennsylvania, Philadelphia). Annu. Rev. Biochem.; 41: 903-24(1972).

The proton transfer theory, catalysis, inductive and charge effects in polypeptides, temperature, solvent effects, isotope effects, and apolar polymer effects in hydrogen exchange chemistry are discussed. In the hydrogen exchange of structured macromolecules, the amount of structure, breathing, and structure change are considered. (115 references) (M.C.G.)

5045 ISOTOPIC EXCHANGE BETWEEN CHEMISORBED NITROGEN AND AMMONIA ON AN IRON CATALYST DESIGNED FOR AMMONIA SYNTHESIS. Boreskova, E. G.; Kuchaev, V. L.; Pen'kovoi, B. E.; Temkin, M. I. (Inst. of Physical Chemistry, Moscow). Kinet. Katal.; 13: No. 2, 358-65(1972). (In Russian).

The isotopic exchange of nitrogen was studied under different conditions of equilibrium for chemisorbed nitrogen with gaseous NH_3 and H_2. An industrial catalyst for NH_3 synthesis was used: 25% FeO–4.8% Al_2O_3, with lesser amounts of K_2O, CaO, SiO_2. The NH_3 was isotopically labeled with 91.6% ^{15}N. The exchange rate at 125 to 200°C decreased exponentially with the extent of the exchange, suggesting a nonhomogeneity in the catalyst surface. Below 125°C a hydrogenated form of N existed on the surface and exchanged more rapidly than chemisorbed N. The hydrogenation rate of the chemisorbed N to form NH_3 coincided with the isotopic exchange rate of N. (K.S.W.)

5046 HETEROEXCHANGE RATE IN THE SYSTEM MOLECULAR OXYGEN–SOLID OXIDE. Muzykantov, V. S.; Panov, G. I. (Inst. of Catalysis, Novosbirsk, USSR). Kinet. Katal.; 13: No. 2, 350-7(1972). (In Russian).

The isotopic exchange of ^{18}O with the oxygen in a number of solid oxides: MgO, Fe_2O_3, MoO_3, Co_3O_4, $CrSbO_4$, and $MeFe_2O_4$, where M = Mg, Co, Cu, of Cd, was studied over a temperature range from 300 to 600°C. The heteroexchange rate is discussed in relation to the isotopic concentration on the catalyst surface and the character of nonhomogeneity. (K.S.W.)

5047 ISOTOPIC EXCHANGE BETWEEN METHANE AND DEUTERIUM IN A STRONGLY ACID MEDIUM. Vostroknutova, Z. N.; Shteinman, A. A. (Inst. of Chemical Physics, Moscow). Kinet. Katal.; 13: No. 2, 324-7(1972). (In Russian).

Experiments showed that methane exchanged H atoms for D in the presence of D_2 in a solution of $HSO_3F–SbF_5$. The reaction was conducted in quartz and the ratio of the components at the start of each experiment was $CH_4 : D_2 : HSO_3F = 1 : 13.7 : 137$. The yield of CH_3D per hour was determined as a function of temperature from room temperature to about 140°C; the activation energy for CH_3D formation was 7.2 kcal/mole. The formation of CH_5^+ and CH_3^+ was postulated as intermediates. (K.S.W.)

5048 REACTIVITY OF OXYGEN ON COMPLEX OXIDE SURFACES. III. ISOTOPIC EXCHANGE WITH SPINELS. Muzykantov, V. S.; Popovskii, V. V.; Boreskov, G. K.; Panov, G. I.; Shkrabina, R. A. (Inst. of Catalysis, Novosibirsk, USSR). Kinet. Katal.; 13: No. 2, 385-92(1972). (In Russian).

The isotopic exchange of oxygen with a series of ferrites $MeFe_2O_4$ (M = Mg, Mn, Fe, Co, Ni, Cu, Zn, or Cd) was studied using ^{16}O and ^{18}O and a mass spectrometer. The oxygen in the surface layer of the ferrites was nonhomogeneous. The exchange mechanism consisted of replacing one atom of molecular O_2 for one atom of O on the ferrite surface. Substituting one divalent metal for another in the ferrospinel series has little effect on the oxygen reactivity of the spinels, which is determined by the nature of the trivalent metal, increasing in the order $MeCr_2O_4$, $MeFe_2O_4$, $MeCo_2O_4$. The activation energy of the homomolecular exchange was studied as a function of the stability of the oxygen bond on the oxide surface with various types of exchange. (tr-auth)

5049 CHEMICAL KINETICS OF THE PYROLYSIS OF HYDROGEN DEUTERIDE. Niki, T.; Mains, G. J. (Univ. of Detroit). J. Phys. Chem.; 76: No. 24, 3538-44(23 Nov 1972).

The chemical kinetics of the pyrolysis of hydrogen deuteride into hydrogen and deuterium was studied mass spectrometrically over the temperature range 833 to 1018°K and in the pressure range 4 to 36 Torr using a double-walled 2-l. quartz reaction vessel. The data fitted a pseudo-first-order reaction equation similar to that found for the reverse combination after an induction period. The induction period was attributed to a rapid heterogeneous reaction which was dominated by the commonly accepted atomic chain mechanism at long times or at higher temperatures. The order of the reaction in the region following the induction period was found to be approximately $^3/_2$ and the overall activation energy was 55.8 ± 2.4 kcal/mol. Rate constants for the chain propagating steps, k_3, k_4, k_5, and k_6 were computed at 1000°K and shown to be consistent with earlier studies using other methods, but computations of k_3 and k_5 were lower than those reported by earlier experimentalists and theoretical predictions. Activation energies were shown to be dependent upon the nature of chain initiation and termination steps and data are reported for E_3, E_4, E_5, and E_6 for two extreme assumptions. The surface to volume ratio was varied by a factor of 2 and 4 and found to have negligible effect in the homogeneous reaction region. Earlier studies of the $H_2 + D_2$ reaction had found an effect attributed to oxygen diffusing through the walls of the reaction vessel but this was not confirmed for the reverse pyrolysis of HD. An ad hoc assumption made by investigators of the $H_2 + D_2$ pyrolysis reaction was shown to be experimentally valid. (auth)

5050 CALCULATION OF THE ISOTOPE SEPARATION FACTOR BETWEEN ARGON LIQUID AND VAPOR. Mandel, Frederic (Univ. of Rochester, NY). J. Chem. Phys.; 57: No. 9, 3929-33(1 Nov 1972).

The Weeks–Chandler–Anderson perturbation theory and the Percus–Yevick theory of fluids are used to calculate $\langle \nabla^2 U \rangle$, the mean Laplacian of the intermolecular potential, from the Lennard–Jones 6–12 potential for liquid and gaseous argon, respectively. The $\langle \nabla^2 U \rangle$'s are then used to calculate the isotope separation factor, which is compared with experiment. The accuracy of the PY equation is estimated by a comparison of a calculation of the compressibility of low density gaseous argon with the experimental data of Levelt. The validity of the WCA approximation is established by the comparison of calculations of $\langle \nabla^2 U \rangle$ with those from molecular dynamics for the Lennard–Jones 6–12 potential. (auth)

5051 REACTIONS OF H_2O^+ AND D_2O^+ WITH MOLECULAR HYDROGEN. I. PROTON AFFINITY OF HYDROGEN. Cotter, R. J.; Rozett, R. W.; Koski, W. S. (Johns Hopkins Univ., Baltimore). J. Chem. Phys.; 57: No. 10, 4100-3(15 Nov 1972).

The cross section of the ion molecule reaction $H_2O^+ + H_2 \rightarrow H_3^+ +$ OH and its deuterium counterpart was studied over an energy range 2 to 100 eV using a tandem mass spectrometer. The measurements permitted a determination of the proton affinity of H_2 of 4.37 ± 0.05 eV and 4.50 ± 0.05 eV for D_2. The energy threshold values indicate that the reaction is proceeding by complex formation at low energies. (auth)

5052 MECHANISTIC INFORMATION FROM PRESSURE AND TEMPERATURE EFFECTS ON THE RATE OF TRANSFER OF ^{18}O FROM AQUOPENTAAMMINECHROMIUM(III) AND AQUOPENTAAMMINERHODIUM(III) IONS TO SOLVENT WATER. Swaddle, T.W.; Stranks, D. R. (Univ. of Calgary, Alberta). J. Amer. Chem. Soc.; 94: No. 24, 8357-60(29 Nov 1972).

The rates of exchange of bound water in $(NH_3)_5MOH_2^{3+}$ with solvent water are characterized by the activation parameters $\Delta V^* = -5.8 \pm 0.2$ cm^3 mol^{-1}, $\Delta H^* = 23.2 \pm 0.5$ kcal mol^{-1}, and $\Delta S^* = 0.0 \pm 1.6$ cal deg^{-1} mol^{-1} when M = Cr; the corresponding data for M = Rh are -4.1 ± 0.4 cm^3 mol^{-1}, 24.6 = 0.3 kcal mol^{-1}, and $+0.8 \pm 1.1$ cal deg^{-1} mol^{-1}. These figures suggest an associative mechanism for both reactions. Some theoretical implications of this conclusion are discussed. (auth)

Feed Materials Processing

Refer also to abstract 5634.

5053 (FRNC-CONF-31) PROCESSING OF WASTE FROM THE LEADING PLANT OF THE CELLIER (LOZERE) URANIUM MINE. Lesty, S. (Compagnie Francaise des Minerais d'Uranium, Paris (France)). 1972. 5p. (In French). (CONF-720454-4). Dep. NTIS (U. S. Sales Only).

From Meeting of the Mineral Section on problems posed by wastes arising from the processing of ores; Paris, France (19 Apr 1972).

The processing of U ores by leaching is discussed: action of H_2SO_4 on ores; precipitation of uranyl sulfate by magnesia in the form of magnesium uranate. The Cellier leaching installations lead to three types of waste: spent ore, solutions arising from neutralization, and effluents connected with the solvents used. Two processing circuits are provided: a circuit for the leaching effluents, and a circuit for effluents from the purification plant. In the first circuit, the acid solutions are neutralized with white lime, the uranium precipitating in the form of calcium uranate. In the second circuit, the pH of the solutions is brought up to a value between 8 and 10 using white lime. (France)

5054 BACTERIAL LEACHING OF METALS FROM ORES. Parab, S. V. Gharat, S. S.; Ramakrishnan, P.; Murthy, T. K. S. (Bhabha Atomic Research Centre, Bombay). pp 303-34 of Recent Developments in Metallurgical Science and Technology. Process Metallurgy. New Delhi; Indian Inst. of Metals (1972).

The present state of knowledge and the major developments in the field of bacterial leaching are reviewed. The discovery of the oxidation of sulfide minerals by bacteria of the Thiobacillus-ferrobacillus group has led to extensive investigations in the application of bacterial leaching of metals, especially from low grade ores. A probable mechanism of bacterial oxidation of sulfides in minerals is suggested. Copper and uranium appear to be the only two metals which are at present recovered on a large scale by this method. Some techniques which are of potential importance in any large scale operation are discussed. The techniques adopted for bacterial leaching of uranium in Canada and at Witwatersrand in South Africa are reported in detail. The future prospects of bacterial leaching of metal ores are discussed. (INIS)

5055 PURIFICATION OF CONCENTRATES. Berberana, M.; San Segundo, T. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 16: No. 77, 321-32(1972). (In Spanish).

The chemical processes in the purification of uranium concentrates, dissolution and filtration, extraction, and re-extraction, are outlined. The installation and its operating conditions are described. The results obtained are reported. (J.S.R.)

5056 ANALYTICAL CHEMISTRY BRANCH. Petrement Equiluz, J. C. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 16: No. 77, 359-68(1972). (In Spanish).

The analytical methods used in the production of U in Spain are summarized. The analysis of U and its compounds and of other materials used in the production process is briefly described. The analytical methods followed in the production control at the different plants are indicated. (J.S.R.)

Radiation Chemistry

Refer also to abstracts 5392, 6796, 6810, and 6813.

5057 (INIS-mf-288, pp 31-31a) APPLICATION OF HIGH-ENERGY RADIATION TO THE STUDY OF ELECTRODE PROCESSES AT PLATINUM. Airey, P. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1972. (CONF-720218-2). INIS.

From third Australian conference on electrochemistry; Terrigal, Australia (15 Feb 1972).

Pt electrodes were irradiated using ^{60}Co γ and 1 MeV electron beam irradiation in hydrogen saturated solutions which facilitate the efficient radical chain decomposition of the radiolytic OH radicals and H_2O_2. Since H· concentration is too low to be kinetically significant quantitative studies can be made of the effect of irradiation on the $H_2 - H^+$ exchange: $H^+ + e_{Pt} \rightleftharpoons \frac{1}{2}H_2$. The electrolyte was dilute H_2SO_4 or $HClO_4$ without supporting electrolyte. Results provided additional evidence for the hydrogen exchange mechanism $H_2(bulk) \rightleftharpoons H_2(Pt)$; $H_2(Pt) \rightleftharpoons H_{Pt} + H_{Pt}$; $H_{Pt} \rightleftharpoons H^+ + e^-_{Pt}$. Radiation reduced anodic and had no effect on cathodic polarizability at moderate voltages; it induced dose rate proportional enhancements in the exchange current densities calculated from low overvoltage anodic polarization data and induced small negative shifts in the rest potential which were independent of total dose but proportional to the dose rate and to the polarization resistance of the electrode. It is proposed that the effect of radiation is to generate electrochemically active sites by the displacement of surface Pt atoms. At equilibrium, in contrast to the situation at moderate overvoltages the reduction component of the exchange reaction is limited by the catalytic combination reaction. (auth)

5058 (ORO-2835-16) PROGRESS REPORT, NOVEMBER 15, 1971-NOVEMBER 15, 1972. (Wake Forest Univ., Winston-Salem, N. C.). 1972. Contract AT(40-1)-2835. 14p. Dep. NTIS.

Studies were made on radicals in irradiated amino acids and other biological materials. Lists of papers published on this research are given. (M.C.G.)

5059 (ORO-3781-9) INVESTIGATION OF GAMMA-RAY INDUCED POLYMER FORMATION OF THE CARBORANES. Annual Progress Report, November 1, 1971-October 31, 1972. Klingen, T. J. (Mississippi Univ., University. Dept. of Chemistry). 1 Nov 1972. Contract AT(40-1)-3781. 43p. Dep. NTIS.

Results are reported on EPR spectral studies on a series of carboranes and their derivatives exposed to γ irradiation at low temperature. The compounds include 1,7-dicarbadodecaborane, decaborane(14), and 1-vinyl-, 1-isopropenyl-, 1-ethyl-, and 1-allyl-1,2-dicarbadodecaborane. Gel permeation chromatography and NMR spectral studies, conducted on the products of the radio-induced polymerization of 1-vinyl-1,2-dicarbadodecaborane, revealed trace amounts of hydrogen and a solid polymeric product having two distinct types of linkages. The mechanism of polymerization was found to be of the free-radical type with a propagation rate constant of about 2×10^2 M^{-1} sec^{-1} and E_a of 3.3 kcal per mole. The effects of radiation dose on the yields of hydrogen and methane in the γ radiolysis of 1-ethyl-1,2-dicarbadodecaborane were studied. Studies on the diffusion of radioinduced free radicals in the plastic crystalline state were begun; cyclohexane was the compound studied. (J.G.B.)

5060 (SGAE-CH-75/1971) CARBOXYLATION OF METHYLAMINE UNDER THE INFLUENCE OF V.U.V. LIGHT AND ^{60}Co γ RAYS. Zich, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). Jun 1971. 15p. (In German). INIS.

Comparable investigations for carboxylation of methylamine by formate or formic acid were carried out under the influence of uv light (147 and 123.6 nm) and ^{60}Co γ rays. The formation of the main product, glycine, was studied as a function of dose, pH, and concentration of both reaction partners. Using a 0.01M methylamine-formate solution the following initial G-values for glycine were obtained: at 123.6 nm $G_1^{ph} = 1.5$, at 147 nm $G_1^{ph} = 1.07$, and for ^{60}Co γ rays $G_1 = 0.4$. Based on the absorbed energy (eV/ml) in the system the carboxylation process is more effective under uv light than under ^{60}Co γ rays. Probable reaction mechanisms for the product formation are discussed. (auth) (INIS)

5061 UNSTABLE INTERMEDIATES. Pt. 118. GAMMA IRRADIATED POTASSIUM AZIDE: ELECTRON SPIN RESONANCE SPECTRA OF N_4^- AND N_3^{2-} RADICAL IONS. Neilson, G. W.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., Faraday Trans., II; 68: No. 10, 1772-7(1972).

After exposure of potassium azide to γ-rays at room temperature both N_4^- and N_3^{2-} were identified by ESR spectroscopy. The latter has not previously been detected in this material, but features previously assigned to pairs of N_4^- radicals are thought to be better identified with N_3^{2-}. This radical is thought to be bent, with a bond angle close to 139°. The ESR parameters are compared with those for other, isoelectronic radicals. (auth)

5062 CHARACTERISTICS OF SOLID-STATE FREE-RADICAL REACTIONS IN IRRADIATED LINEAR AND CYCLIC PEPTIDES. Panin, V. I.; Molodov, L. A.; Usatyi, A. F. High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 118-23(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 135-41(1972).

The ESR method (170 and 300°K) was used to investigate the free-valence localization in irradiated cyclic alanine-glycine peptides. It was established that primary . . . ~ HĊR radicals produced by rupture of the peptide chain, when heated, enter into secondary reactions involving detachment of a hydrogen atom from the amino acid residues of adjacent molecules. The terminal free radicals . . . -NH-ĊR′-CO- . . . (R′ = H, CH_3) and the corresponding organic acids or amines are ultimately formed. The reactions are accompanied by transformation of the ESR spectra. The conditions affecting the efficiency of H-atom transfer in irradiated linear and cyclic peptides were determined and it was shown that NMR spectroscopy can be used to identify the final nonradical products of the secondary reactions. (auth)

5063 SPACE-CHARGE ACCUMULATION AND RELAXATION IN POLYMERS. Vorob'ev, A. A.; Evdokimov, O. B.; Tubalov, N. P. (Tomsk Polytechnical Inst., USSR). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 124-6(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 142-5(1972).

Samples of poly(methyl methacrylate), polystyrene, and Viniplast (rigid PVC) were irradiated with 1-MeV electrons at beam current densities of 0.5 to 0.005 $\mu A/cm^2$ in order to investigate space-charge accumulation. The number of electrons passed was measured simultaneously. It is proposed that charge accumulation in the dielectric be judged on the basis of measurement of the extrapolated paths from the absorption curves. It is shown that on increasing the beam current density to 0.5 $\mu A/cm^2$ the magnitude of the charge increases, and the specific conductivity during irradiation increases in the order Plexiglas, Viniplast, polystyrene; the size of the region in which the beam energy is absorbed depends on the specific conductivity during irradiation. It is proposed that the absorption of β particles in the charged polymers be measured to investigate the charge-decrease process. On the basis of this method it is shown that the charge in the investigated Plexiglas and polystyrene samples decreases after ~ 10 and 6 days, respectively. In both cases, there are two components – fast and slow. (auth)

5064 RADIATION STABILITY OF THE SALT FORMS OF THE ANION EXCHANGER AV-17-8. Roginskaya, B. S.; Bychkov, N. V.; Kasperovich, A. I. High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 127-9(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 146-8(1972).

It is shown that the rate for the radiation destruction of quaternary ammine groups of the AV-17-8 anion exchanger in the hydroxyl and salt forms can be represented by a first-order equation. The stability of the strongly basic groups decreases as the equivalent moisture capacity (swelling ability) of the anion exchanger increases. The rate of formation of weakly basic groups depends on the type of sorbed anion and is independent of the swelling ability of the anion exchanger. (auth)

5065 SOLVATED ELECTRON IN IRRADIATED WATER–AMMONIA MIXTURES. Khaikin, G. I.; Zhigunov, V. A.; Dolin, P. I. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 130-3(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 149-52(1972).

The optical absorption spectra and reaction kinetics of the solvated electron in a water–ammonia system irradiated by fast electrons was studied by the pulse radiolysis method in combination with rapid spectrophotometry. In all the mixtures studied the optical spectrum of the solvated electron is a single band, whose position is determined by the composition of the mixture. The positions of the maxima for these bands were determined for several water–ammonia solutions, and the dependence of the transition energy which corresponds to the maximum in optical absorption on the composition of the system was obtained. The kinetics of destruction of solvated electrons after the end of the radiation pulse action was studied in the temperature range 213 to 295°K. Treatment of the kinetic data by the differential method, with variation of the initial electron concentration, has made it possible to separate out the pseudomonomolecular reaction with ammonium ion from the concurrent reactions. Values are given for the activation energies and preexponential factors of this reaction with various water contents. (auth)

5066 THERMAL AND PHOTOLYTIC CONVERSIONS OF THE PRIMARY PRODUCTS FROM THE LOW-TEMPERATURE γ-RADIOLYSIS OF THE CRYSTALLINE HYDRATE $NaOH \cdot 3.5H_2O$. Puntezhis, S. A.; Ershov, B. G.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 134-7(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 153-6(1972).

An investigation was carried out of the transformations undergone by F-centers and O^- ion–radicals, formed during the low-temperature γ-radiolysis of the crystalline hydrate $NaOH \cdot 3.5H_2O$. The temperature regions in which these particles disappear were determined. The kinetics of the thermally and photolytically induced destruction of the F-centers was measured. It was found that under certain conditions F-centers are bleached with the formation of F'-centers (the optical absorption band having λ_{max} at 550 nm). (auth)

5067 BEHAVIOR OF STABILIZED ELECTRONS IN GLASSY ALCOHOLS AT 77°K. Smirnov, V. A.; Alfimov, M. V. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 156-8(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 178-80(1972).

In order to study the behavior of stabilized electrons in glassy alcohols during visible light bleaching, dependence of the efficiency of the formation of alcohol radicals and the magnitude of the photocurrent of the wave length of the bleaching light was investigated. The behavior of the electrons during bleaching can be explained by the following scheme. Long wavelength light disrupts the trap in which the electron is located; as a result of this, an alcohol radical is formed. Short wavelength light can knock the electrons out into the conductivity zone. Judging by the efficiency of the formation of photocurrent, the path length of the electron depends on the kinetic energy acquired by the electron as it leaves the trap. Upon diffusing through the matrix, the electron either reacts with the alcohol or is thermalized and again stabilized in a trap. It can be assumed that the reaction of the electron plays a large role during the radiolysis of alcohols, because a correlation in the formation of radicals during bleaching of the electrons formed during the photolysis and radiolysis of benzene solution in methanol is observed. (D.H.M.)

5068 NATURE OF THE RADICALS IN γ-IRRADIATED SOLID PIPERIDINE. Trofimov, V. I.; Chkheidze, I. I.; Blyumenfel'd, A. L. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 166-7(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 185-6(1972).

The ESR spectrum of the radicals in γ-irradiated frozen aqueous solutions of piperidine solutions was investigated. It was concluded that the radical $HN(CH_2)_4\dot{C}H$, in which $a_{H_\alpha} = 150e$, $a_{H_\beta}^{CH_2} = 40$ Oe, is the only radical to which the spectrum from γ-irradiated frozen aqueous piperidine solutions heated from −196 to −30°C can be attributed. (D.H.M.)

5069 REACTIONS OF Pt(IV) AND Pt(II) COMPLEXES WITH ATOMIC HYDROGEN. Shagisultanova, G. A.; Karaban, A. A.; Tikhonov, A. S.; Gorbunova, S. P. (Minsk State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 168-9(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 186-8(1972).

In an effort to understand the mechanism of reactions of Pt(IV) and Pt(II) complexes with free radical products of the radiolysis of water, model reactions of atomic hydrogen, generated in high-frequency electrodeless discharge zones, with the following complexes containing σ- and π-donor ligands: $Na_2[PtCl_6]$, $[Pt en_3]Cl_4$, trans-$[Pt\ en_2Cl_2]Cl_2$, and $[Pt\ en_2]Cl_2$ were investigated. It was concluded that the reduction reactions of Pt(IV) and Pt(II) complexes are multistage processes. They include formation of different valence states of Pt. (D.H.M.)

5070 RADIATION STABILITY OF POLYDIMETHYLSILOXANES CONTAINING METHYLPHENYL- OR DIPHENYLSILOXANE GROUPS IN THE DECOMPOSITION OF MOLECULES INTO RADICALS. Kozlov, V. T.; Evseev, A. G.; Karlin, A. V.; (and others) High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 170(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 188(1972).

Data are presented on the influence of the molecular structure of polydimethylsiloxanes containing various amounts of methylphenyl- or diphenylsiloxane groups on the radiation stability of polymer molecules to decomposition into radicals at 77°K, determined as the quantity 1/G(R) (G(R) is the radiation yield of radicals, determined according to the linear portions of the curves of accumulation of radicals in the dose range 1 to 80 Mrad with a standard ESR spectrometer at 77°K). (auth)

5071 RADIATION YIELDS OF TRIPLET MOLECULES IN FROZEN SOLUTIONS. Alfimov, M. V.; Buben, N. Ya.; Shamshev, V. N. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 171-2(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 188-9(1972).

Radiation yields of triplet molecules, G_T, in frozen solutions (T = 100°K) of naphthalene, octadeuteronaphthalene, coronene, and decadeuteriobiphenyl in polystyrene and of octadeuterionaphthalene in poly(methyl methacrylate), methylcyclohexane, toluene, and in a mixture of octyl and isoamyl alcohols were measured. Data show that the radiation yields of triplet molecules of additives in polystyrene are identical for all additives in the limits of accuracy of the measurements. At the same time G_T changes very significantly for octadeuteronaphthalene in various solvents; from six in toluene to a very small value in the alcohol mixture. Thus, it can be concluded that upon radiolysis of solid organic mixtures the radiation yield of triplet molecules of additive is determined mainly by the properties of the solvent matrices. (D.H.M.)

5072 DISTINCTIVE FEATURE OF γ RADIOLYSIS OF ETHANE NEAR ITS LIQUID–GAS CRITICAL POINT. Shaulov, A. Yu.; Titov, V. B.; Brodskii, A. M. (Inst of Petrochemical Synthesis, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 175-6(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 192-3(1972).

The γ radiolysis of ethane near the liquid–gas critical point was investigated. Results show that a marked increase in the overall yield of gaseous radiolysis products is observed near the liquid–gas critical point. (D.H.M.)

5073 RADIATION-INDUCED CONVERSIONS OF EPOXY RESINS. Sidyakin, P. V.; Karpov, V. L.; Egorov, B. N. High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 177-9(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 193-5(1972).

The radiation-induced conversions of epoxy resins of low and high molecular weight (MW) were investigated by ir spectrometry, mass spectrometry, chromatography, x-ray analysis, ESR, thermo mechanical measurements, chemical analysis, and viscosimetry. It was established that radiation-induced degradation of epoxy resins occurs mainly by removal of the end propylene oxide groups, which is indicated by the fall in the relative intensity of the 1040 (breaking of the O–C bond in the –O–C group), 2870 and 2930, and 1420 cm^{-1} (decrease in the content of the $-CH_2-$ and $-CH_2CO$ groups) ir spectrum bands and also of those at 920 and 870 cm^{-1} (conversion of epoxy groups). (D.H.M.)

5074 E.S.R. STUDY OF THE ELECTRON TRAPPING CENTRE IN A SINGLE CRYSTAL OF MALEIC ACID IRRADIATED AT 77°K. Eda, B.; Iwasaki, M. (Government Industrial Research Inst., Nagoya, Japan). Mol. Phys.; 24: No. 3, 589-95(Sep 1972).

Evidence for an electron trapping centre produced by ionizing radiations in a single crystal of maleic acid was obtained by electron spin resonance. When the crystal is irradiated at 77°K several paramagnetic species are produced. One of them is the species in which the unpaired electron occupies the delocalized π orbital and interacts with the two vinylene protons. The hyperfine tensors of the two vinylene protons, which are typical of α proton coupling, are (–13.0, –8.5, –3.2) and (–6.4, –5.2, –1.9)G, respectively. The g tensor is (2.0043, 2.0040, 2.0024). The principal directions of the hyperfine and g tensors give information about the electron trapping centre in which the framework of the molecule is preserved. The probable structure of this centre is the delocalized carboxyl anion although the possibility of its protonated form cannot be completely excluded. (auth)

5075 RADIOLYSIS OF SOLUTIONS OF MANGANOUS CHLORIDE IN METHYL ALCOHOL AT 77°K. Abdrashitov, E. F.; Tikhomirov, L. A. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 173-4 (1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 190-1(1972).

Experimental data on the efficiency of radiation transformations in the vicinity of metal ions were obtained from an investigation of the radiolysis kinetics of frozen solutions of manganous chloride in methyl alcohol. Whereas the ESR signal intensity of Mn^{2+} decreases with dose, the optical density of the absorption spectrum increases to 100 Mrad, displaying no further change with an increase in the dose. This is further confirmation that both phenomena are due to radiation disturbances in the solvate layer. (D.H.M.)

5076 RADIOLYSIS OF POLYISOBUTYLENE. Staren'kii, A. G.; Lavrentovich, Ya. I.; Kabakchi, A. M. (Inst. of Physical Chemistry, Kiev). Vysokomol. Soedin., Ser. B; 14: No. 5, 377-81(May 1972). (In Russian).

The effects of ^{60}Co γ radiation, deuterons, and α particles on poly(isobutylene) (PIB), and the buildup of vinylidene and diene bonds in this polymer were studied. The destructive effects of radiolysis decreased with increase in the linear energy transfer. Heavy charged particles were less effective in forming vinylidene and diene bonds than γ radiation. Probable mechanisms are discussed. (K.S.W.)

5077 INFLUENCE OF γ-RADIATION ON THE STRUCTURE OF POLY(VINYLIDENE FLUORIDE). Kosmynin, B. P.; Gal'perin, E. L. Vysokomol. Soedin. Ser. A; 1603-1611(Jul 1972). (In Russian).

Changes in the crystalline and supermolecular structures of poly (vinylidene fluoride) (PVF_2) were studied as affected by the γ dose. On irradiation of starting PVF_2 powders with a dose equal to up to 1000 Mrad, its crystal lattice spacings do not change significantly, whereas irradiation of block samples, both nonoriented and oriented, results in considerable changes in the unit cell (α and β forms). Simultaneously the long period and the size of crystallites undergo changes, and the crystalline and supermolecular structures of PVF_2 break up. Some suggestions are made about the reasons of different radiation resistance of various crystalline forms and powders of PVF_2. (tr-auth)

5078 ELECTRONS AND TRAPPED ATOMIC HYDROGEN IN AN ACID GLASS. Kaalhus, O. (Norsk Hydro's Inst. for Cancer Research, Oslo). Nature (London) Phys. Sci.; 239: No. 94, 111-12(16 Oct 1972).

The sequence of events leading to the trapping of H-atoms in x-irradiated glasses and ices was thoroughly investigated by Weiss and Moorthy and by Kevan, and a remarkable proportionability found between electron reactivities in the solid and the aqueous phase. Measurements of mobile electron scavenging rates in a glycol/water glass, however, have not shown simple correspondence between the reactivities of e^-_m and e^-_{af}. In earlier experiments, however, the possible existence of an intermediate mobile radical between the electron and trapped H cannot, however, be excluded. ESR experiments to resolve this question are described. It was shown that the immediate precursor to trapped H-atoms in an x-irradiated acid glass at 77°K is a mobile H species and not the mobile electron. It was also clear that it is difficult to extrapolate information obtained concerning the radiolysis of low temperature glasses to radiolytically induced processes in aqueous solution. (UK)

5079 GAMMA-RADIATION EFFECTS ON SOME PROPERTIES OF FLUOROLONES. Berlyant, S. M.; Gavlovskii, A. A.; Karpov, V. L. Plast. Massy; No. 2, 6-7(Feb 1972). (In Russian).

The effects of γ radiation on some properties of 40P and 42P fluorolones (copolymer of vinylidene fluoride and tetrafluorothylene) are reported. A high rate of crosslinking occurred in a vacuum in an ionizing radiation field. During irradiation in air destructive processes predominated. Thermomechanical studies of the irradiated fluorolones were conducted, and their stability characteristics were evaluated as functions of the absorbed dose at various temperatures. (tr-auth)

5080 RADIATION CHEMISTRY OF 1-CHLOROPENTANE IN THE SOLID PHASE. I. INFLUENCE OF THE DOSE. Ceulemans, J.; Claes, P. Bull. Soc. Chim. Belg.; 81: No. 7-8, 405-16(1972).

The influence of the dose on the yields of the radiolysis products of 1-chloropentane, irradiated in the solid phase by gamma rays of a ^{60}Co source, was investigated. A decrease of the yield of hydrogen, hydrogen chloride, the pentenes, the decanes and of certain chlorodecanes and an increase of the yield of pentane and of certain dichloropentanes and dichlorodecanes in function of the dose is observed. Some of these dose effects cannot be explained by a purely radicalar mechanism, but they may be explained by a mechanism, which includes radicalar and ionic reactions. It must therefore be concluded that ionic species play an important role in the radiolysis of solid 1-chloropentane. The effects, invoked to explain the influence of the dose on the G yields, are reactions of active species with unsaturates formed during the radiolysis or with trapped radicals. (auth)

5081 RADIATION CHEMISTRY OF 1-CHLOROPENTANE IN THE SOLID PHASE. II. INFLUENCE OF UNSATURATES. Ceulemans, J.; Claes, P. Bull. Soc. Chim. Belg.; 81: No. 7-8, 417-24(1972).

The influence of cyclohexene and 1-pentene on the yield of the products of the radiolysis of solid 1-chloropentane was studied. The observed influence can be explained by an earlier proposed radiolysis mechanism which contains radicalar and ionic reactions. (auth)

5082 DETECTION OF PARAMAGNETIC DIMERS OF $AgHg^{2+}$ AND $AgHgOH^+$ BY EPR. Simons, M. Ts. R.; Marov, I. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Neorg. Khim.; 17: No. 10, 2601-3(Oct 1972). (In Russian).

The EPR method was used to investigate gamma-irradiated solutions of salts of Ag(I) and Hg(II) and their mixtures. Frozen solutions at 77°K were irradiated for 2 hr with a ^{60}Co source and were then examined with a Varian E-3 spectrometer. Very complex spectra resulted from various paramagnetic forms of Ag, the relative concentration of which depended on the concentration of $HClO_4$ used in preparing the test solutions of Ag_2CO_3 and $Hg(ClO_4)_2$. In mercuric salt solutions two Hg^+ compounds were established: an aquo- and a hydroxy-complex. In the mixed silver–mercuric solutions the existence of $AgHg^{2+}$ and probably $AgHgOH^+$ were detected. (K.S.W.)

5083 STABILITY OF ION EXCHANGE RESINS. Pt. II. RADIATION STABILITY. Moody, G. J.; Thomas, J. D. R. (University Coll. of South Wales, Cardiff, Eng.). Lab. Pract.; 21: No. 10, 717-22(Oct 1972).

The action of ionizing radiations on various ion exchange resins is discussed, together with a brief account of the methods for assessing the radiation effects. (auth)

5084 CONCERNING THE DIRECT EFFECT IN THE RADIOLYSIS OF 0.4 M SULFURIC ACID. Lesigne, B. (CEN de Saclay, Gif-sur-Yvette, France); Ferradini, C.; Pucheault, J. J Phys.. Chem.; 76: No. 24, 3676(23 Nov 1972).

In the course of work on the pulse radiolysis of vanadium(IV) and (V) in aqueous solutions containing sulfuric acid, the absorption spectra was studied of deaerated 0.4 M solutions of sulfuric acid, free from other solutes, subjected to a 12-nsec pulse of 1.8 MeV electrons. A transient species that was present less than 10 nsec after the end of the pulse was observed. The spectrum

corresponds to that attributed to the radical ion SO_3^-. It is believed to be produced by direct action upon sulfuric acid. (D.H.M.)

5085 CrO_3^- RADICAL IN γ-IRRADIATED POTASSIUM CHROMATE AND CHLOROCHROMATE. Debuyst, R.; Ladriere, J.; Apers, D. J. (Univ., Louvain, Belgium). J. Inorg. Nucl. Chem.; 34: No. 12, 3607-14(Dec 1972).

When single crystals of potassium chromate and potassium chlorochromate were exposed to ionizing radiation at room temperature, a paramagnetic species was observed, which was common to the two matrices. In K_2CrO_4 the g values are: g_x = 1.9078; g_y = 1.9606; g_z = 1.9879. In $KCrO_3Cl$ they were: g_x = 1.9055; g_y = 1.9879; g_z = 1.9816. The hyperfine tensor A was determined in the $KCrO_3Cl$ case: $|A_x|$ = 35.6 gauss; $|A_y|$ = 5.0 gauss; $|A_z|$ = 10.9 gauss. Several arguments agree with the assumption that the signal observed belongs to a CrO_3^- radical. (auth)

5086 PULSED VACUUM-UV PHOTOCHEMICAL STUDY OF REACTIONS OF OH WITH H_2, D_2, AND CO USING A RESONANCE-FLUORESCENT DETECTION METHOD. Stuhl, F.; Niki, H. (Ford Motor Co., Dearborn, MI). J. Chem. Phys.; 57: No. 9, 3671-7(1 Nov 1972).

Resonance fluorescence ($A\ ^2\Sigma^+$; $v' = 0 \rightarrow X\ ^2\Pi$; $v'' = 0$) was used to monitor OH radicals in the pulsed vacuum-uv photolysis of H_2O. From the exponential decays of OH radicals in the presence of a large excess of added reactants, absolute rate constants of the following reactions were determined at 298°K: $OH + CO \rightarrow CO_2 + H$, $k_4 = 1.35 \times 10^{-13}$ cm^3 molecule^{-1}·sec^{-1}; $OH + H_2 \rightarrow H_2O + H$, $k_5 = 7.1 \times 10^{-15}$ cm^3 molecule^{-1}·sec^{-1}; $OH + D_2 \rightarrow DHO + D$, $k_6 = 2.05 \times 10^{-15}$ cm^3 molecule^{-1}·sec^{-1}. The overall uncertainty of these rate constants was estimated to be ±15%. The methods for production and detection of OH are discussed in detail. (auth)

5087 EPR STUDIES OF THE UV-INDUCED FREE RADICAL CONVERSION IN γ-IRRADIATED AMINO ACID CRYSTALS. Fujimoto, M.; Saito, S. (Univ. of Guelph, Ont.). J. Chem. Phys.; 57: No. 9, 3704-8(1 Nov 1972).

Ultraviolet energy absorbed by γ-irradiated α-amino acids (glycine, L-alanine, and methylalanine) at 77°K was found to induce a conversion of the trapped radical to another species, which was identified as $(NH_2CRR'CO_2H)^-$ (R, R' = H, CH_3). The latter radical was stable in the temperature range 77 to 250°K, but converted irreversibly back to the former, on raising the temperature beyond 250°K. At room temperature, uv irradiation induced no particular effect except for a noticeable loss in EPR intensity. It was interpreted that the uv excitation in the trapped radical caused a subsequent electron transfer to an adjacent host molecule. During the thermal process above 250°K, most of the captured electrons are believed to return to the original radicals. (auth)

5088 REACTIONS OF THE CATION AND ANION RADICALS OF SEVERAL DNA BASES. Sevilla, M. D.; Van Paemel, C.; Zorman, G. (Oakland Univ., Rochester, MI). J. Phys. Chem.; 76: No. 24, 3577-82(23 Nov 1972).

The reactions of the π-cation and anion radicals of several DNA bases are investigated in a number of aqueous glasses. For thymine and 5-methylcytosine the π-cations initially formed at 77°K react upon warming in 8 N NaOH or 5 M K_2CO_3 by deprotonation of the methyl group to produce a RCH_2· radical. This is verified by the production of the RCH_2· radical by an independent radiolysis method in the case of thymine. Results are found which indicate possible cation radical decomposition in the cases of thymidine and 5-methyldeoxycytidine. Computer simulations of the glassy spectra expected for the thymine RCH_2· radical where the nitrogens are either protonated or unprotonated suggest splittings near 17 G for the CH_2 group and 6 G for the 6-position proton in the unprotonated case. The anion of thymine in 12 M LiCl which is stable at low temperatures is found to protonate upon warming to form the 5,6-dihydro-5-thymyl radical. Identical results are found for thymidine. The results found for the reactions of cation and anion radicals are discussed in terms of results found in crystalline DNA bases and recent pulse radiolysis results. A mechanism of radiation damage to DNA is discussed. (auth)

5089 ELECTRON SPIN RESONANCE STUDY OF SEVERAL DNA BASE CATION RADICALS PRODUCED BY PHOTOIONIZATION. Sevilla, M. D.; Van Paemel, C.; Nichols, C. (Oakland Univ., Rochester, MI). J. Phys. Chem.; 76: No. 24, 3571-7 (23 Nov 1972).

π-Cation radicals of a number of DNA bases were produced in aqueous glasses (8 N NaOD, 5 M K_2CO_3–D_2O, 5.7 M D_3PO_4) at low temperature by uv photolysis. Well-resolved ESR spectra of π-cations of 5-methyl-cytosine (NaOD, K_2CO_3, D_3PO_4), thymine (K_2CO_3), and thymidine (NaOD) are found and reduced to hyperfine coupling constants. The methyl proton splittings for π-cations of 5-methylcytosine show a great dependence on pH. The methyl proton splitting is 20 G in 5 M K_2CO_3 and 5.7 M D_3PO_4, whereas in 8 N NaOD it is 14 G. This lowered splitting is explained by a comparison of the experimental results with the theoretical splittings based on McLachlan MO computations. This comparison suggests that at high pH the amino nitrogen loses one proton and fully conjugates with the ring π-electron system. Results found for thymine in 5 M K_2CO_3 are nearly identical with previous results in NaOD and D_3PO_4. The thymidine π-cation is found to have similar splittings to the thymine π-cation, however, anomalously low g values are found for this radical. (auth)

5090 CHANGES IN FLUOROLONE STRUCTURE FOLLOWING IRRADIATION. Abramova, I. M.; Burlak, L. F.; Kazaryan, L. G.; Tikhomirov, V. S.; Serenkov, V. I. Plast. Massy; No. 12, 34-7(Dec 1971). (In Russian).

Changes in the structure of fluorolone (a copolymer of vinylidene fluoride and tetrafluoroethylene) with the effects of γ radiation at 25 and 150°C are described. The latter effects include cross-linking and destruction. As the temperature was increased, the share of the participation of vinylidene fluoride units in the destructive process increased. With increased radiation dose, crystal defects of the polymer and interplanar distances increase. (tr-auth)

5091 PARAMAGNETIC CENTERS IN X-IRRADIATED CHRYSENE SINGLE CRYSTALS. Jennings, R. W.; Wilson, L. K. (Vanderbilt Univ., Nashville). Mol. Cryst. Liquid Cryst.; 17: No. 3-4, 315-25(Jul 1972).

An x-irradiated single crystal of chrysene, $C_{18}H_{12}$, was investigated by electron spin resonance to determine the types of stable-free radicals formed by the radiation. The single crystal was grown at room temperature from a solution of chrysene in dimethylformamide. The ESR spectrometer was operated at approximately 9.5 GHz with 100-kHz field modulation and phase-sensitive detection. The spectra were recorded at 10° intervals for rotation of the magnetic field about each of the three orthogonal axes, abc*. The spectrum of chrysene exhibited a triplet characteristic, similar to that previously reported for benzene, naphthalene, and anthracene. The hyperfine structure in the spectrum is interpreted as a doublet-triplet–triplet spectrum with the doublet exhibiting the anisotropic characteristics that are associated with an α-proton interaction. The hyperfine spectrum is superimposed on a poorly resolved isotropic doublet. The hyperfine spectrum is interpreted as being associated with a hydrogen addition free radical, and the poorly resolved doublet is assigned to a hydrogen abstraction radical. The interpretation is consistent with results for benzene, naphthalene, and anthracene. (auth)

5092 STUDY OF THE RADIOLUMINESCENCE OF ALIPHATIC SOLUTIONS OF 4-BUTYL-2-BIPHENYL-5-PHENYL-1,3,4-OXADIAZOLE. Paligoric, D.; Klein, J. (Centre National de la Recherche Scientifique, Strasbourg). Int. J. Radiat. Phys. Chem.; 4: No. 3, 359-68(Aug 1972). (In French).

An experimental study of the time evolution of the intensity of radioluminescence induced by α- and β-radiation in aliphatic solvents (cyclohexane and n-hexane) containing an aromatic fluorescent solute in low concentration is presented. Two components of the evolution were determined: a "slow" one which was attributed to the radiative deactivation of solute molecules excited during ion recombination which is strongly inhibited by charge scavengers ($CHCl_3$, C_2H_5OH), and a "quick" one which is very little sensitive to the presence of scavengers and implies energy transfer between solvent and solute and excitation of the solute by subexcitation electrons. An effect on the radioluminescence of the L.E.T. of the irradiating particles was also found. (auth)

5093 γ-RADIATION-INITIATED OXIDATION OF ISOSAFROLE IN ACETIC ACID. Baranova, N. M.; Komarov, P. N. High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 114-17(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 131-4(1972).

The effect of the nature and volume of the solvent and also of the concentrations of isosafrole and oxygen on the γ-radiation-initiated oxidation of isosafrole at 23°C was investigated in, for example, toluene and acetic acid. It was shown that toluene is an essentially inert solvent, whereas acetic acid considerably accelerates the process. The oxidation of isosafrole in acetic acid is a nonbranching chain process whose rate may be evaluated by use of the equation $V = k[O_2][M][AcOH]^n$. (auth)

5094 MACROMOLECULAR SCIENCE. Bawn, C. E. H. (ed.). MTP International Review of Physical Chemistry, Series One, Volume 8. Baltimore; University Park Press (1972). 377p. $24.50.

Coverage and critical assessment of work carried out in the past five years in the broad areas of synthesis and properties of polymers and the relationships between polymer properties and

molecular structure are presented. Three of the eight chapters are abstracted separately in NSA. (J.G.B.)

For abstracts of individual chapters see: 5095–5097.

5095 CATIONIC POLYMERISATION. Kennedy, J. P. (Univ. of Akron, OH). pp 49-103 of Macromolecular Science. /Bawn, C. E. H. (ed.). Baltimore; University Park Press (1972).

Structural formulas of cationically polymerizable compounds are given. Carbenium ion mechanisms are discussed from the standpoint of initiation, propagation, transfer, and termination. Radiation effects on propagation are considered. (117 references) (J.G.B.)

5096 POLYMER DEGRADATION. Grassie, N. (Univ. of Glasgow). pp 277-328 of Macromolecular Science. /Bawn, C. E. H. (ed.). Baltimore; University Park Press (1972).

Polymers considered are: poly(vinyl esters), hydrocarbon polymers, methacrylate and acrylate polymers, those with heteroatoms in the chain backbone, and those with aromatic groups in the chain backbone. Important aspects of polymer degradation including that induced by heat, light, oxygen, high-energy radiation, and mechanical means are discussed. (343 references) (J.G.B.)

5097 DIFFUSION IN POLYMERS. Stannett, V.; Hopfenberg, H. B.; Petropoulos, J. H. (North Carolina State Univ., Raleigh). pp 329-69 of Macromolecular Science. /Bawn, C. E. H. (ed.). Baltimore; University Park Press (1972).

Diffusion in polymers is discussed from the standpoint of theoretical developments, methods of measurement, transport of gases, transport of organic penetrants, and transport of water vapor. Certain aspects of the role of radiation in the diffusion of polymers are included in the review. (J.G.B.)

5098 DECAY OF QUASI-FREE ELECTRONS IN PULSE-IRRADIATED LIQUID HYDROCARBONS. Bakale, G.; Gregg, E. C.; McCreary, R. D. (Carnegie–Mellon Univ., Pittsburgh). J. Chem. Phys.; 57: No. 10, 4246-54(15 Nov 1972).

The decay of the ion current in pulse-irradiated hydrocarbons in a parallel-plate ion chamber was observed in the nsec-μsec time range during which time the major contribution to the ion current is the quasifree, high mobility electron. At dose rates of 10^{15} eV $cm^{-3}/10^{-8}$ sec the electron current decay is exponential with a half-life ranging from ~5 nsec (cyclopentane) to >400 nsec (n-hexane). At higher dose rates, however, deviation from the exponential decay occurs and second-order decay is approached at the highest doses/pulse (6.5×10^{16} eV–$cm^{-3}/10^{-7}$ sec) studied. This change from pseudo-first-order to second-order kinetics is interpreted as a change in the electron decay from an attachment type process to electron–ion recombination. Absolute rate constants for the electron reacting with several solutes in n-hexane were also determined; these are $k_s(e^- + CCl_4) = k_s(e^- + \phi_2) = 1.0 \pm 0.1 \times 10^{12}$, $k_s(e^- + I_2) = 2 \pm 1 \times 10^{11}$, $k_s(e^- + H_2O) \simeq k_s(e^-$ + benzene) $\leq 1 \times 10^9$, and $k_s(e^- + O_2, CO_2, N_2O, SF_6) \leq 2 \times 10^8\ M^{-1} \cdot sec^{-1}$. (auth)

5099 LITHIUM NIOBATE COLORATION CAUSED BY HYDROGEN ION BOMBARDMENT. Primak, William (Argonne National Lab., IL). J. Chem. Phys.; 57: No. 10, 4354-6(15 Nov 1972).

Bombardment with 140 keV protons or deuterons developed a broad absorption band extending from about 1 μ to the absorption edge at about 0.33 μ. The mean absorption coefficient increased quite linearly with ion dose until destruction of the surface occurred (~0.05 C/cm^2) and reached values ~1.6 μ^{-1}. Although the absorption band was similar to that developed by ionization (e.g., by electron bombardment), thermal annealing was quite different. The absorption band developed by ionization alone annealed by 140°C, while the proton one annealed mainly in the 100° above 220°C. The coloration was not observed following He^+ or Ne^+ bombardment. A specimen exposed in a nuclear reactor developed coloration, but the coloration was 70-fold less per hydrogen (isotope tritium, calculated from neutron fluence, concentration 3 orders of magnitude less than the proton or deuteron concentration above). (auth)

5100 ENDOR MEASUREMENTS OF PROTON HYPERFINE COUPLINGS. Box, H. C.; Freund, H. G.; Budzinski, E. E. (Roswell Park Memorial Inst., Buffalo). J. Chem. Phys.; 57: No. 10, 4290-4(15 Nov 1972).

ENDOR (electron-nuclear double resonance) spectroscopy was used to measure hyperfine couplings in radicals in which the unpaired spin density is concentrated mainly on atoms two bond lengths removed from the proton. The measurements were made on radicals produced by x irradiation of single crystals of succinic acid and glycine hydrochloride. The anisotropic part of the hyperfine coupling, as a function of the isotropic coupling, was obtained for two types of radicals: (1) neutral radicals obtained by irradiation of certain carboxylic acids and amino acids at room temperature in which the unpaired spin density is localized primarily in a π2p carbon orbital, and (2) radical anions obtained by irradiation of certain carboxylic acids and amino acids at 4.2°K in which the unpaired electron is localized primarily in a π2p carbon orbital on the carboxyl group. (auth)

5101 RADIATION DAMAGE TO PEPTIDES: AN ENDOR STUDY OF X-IRRADIATED ACETYLGLYCINE. Box, H. C.; Budzinski, E. E.; Lilga, K. T. (Roswell Park Memorial Inst., Buffalo). J. Chem. Phys.; 57: No. 10, 4295-8(15 Nov 1972).

ENDOR spectroscopy and isotopic substitution were used in a study of the paramagnetic species produced by x irradiation in single crystals of acetylglycine maintained at 4.2°K. A reduced species was identified which is formed by the addition of an electron to oxygen of the peptide link. Another reduced species, formed by the addition of an electron to the carboxyl group, occurs in two conformations. The oxidized species decomposes losing a proton and CO_2. (auth)

5102 γ-RADIOLYSIS OF SOME 1,4-QUINONES IN BENZENE. Wilson, J. G.; Sweeting, J. W. (Australian Atomic Energy Commission, Sutherland). Aust. J. Chem.; 25: No. 9, 1877-86(Sep 1972).

The γ-radiolysis of several 1,4-quinones in benzene solution was studied. 1,4-Benzoquinone, 1,4-naphthoquinone, and 2-phenylnaphthoquinone undergo nuclear phenylation in deaerated solution. In aerated solution 1,4-benzoquinone is exceptional in being converted into 4-hydroxydiphenyl ether. Possible mechanisms for the formation of the radiolysis products are discussed. (auth)

5103 CHEMICAL TRANSFORMATIONS OF POLYCAPROAMIDE IN THE PRESENCE OF SECONDARY AROMATIC AMINES FOLLOWING IRRADIATION. Furman, E. G.; Abramova, T. M.; Dar'eva, Eh. P.; Spirina, I. A.; Fomenko, A. S. Plast. Massy; No. 1, 12-14(Jan 1972). (In Russian).

The influence of secondary aromatic amines on the radiation-chemical induced transformation of polycaproamide was studied. The protective effect of secondary arylamines during radiation oxidation of polyamides arose due to the reaction of peroxide radicals with amines, which lead to a breaking off of the chains and the appearance of stable nitrite radicals in place of reactive peroxides. (tr-auth)

5104 PHYSICAL CHEMISTRY OF THE ELECTRON IN A CONDENSED MEDIUM. Pikaev, A. K.; Brodskii, A. M. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 3, 201-13(1972).

Translated from Khim. Vys. Energ.; 6: No. 3, 224-38(1972).

The experimental and theoretical data on the properties of electrons in condensed media that have been obtained in the last two years are reviewed. Special attention is directed toward the classification of states of the electron in these media, the theory of formation of solvated electrons, their reactivity, and the effect of structure of the medium on properties of the electron. (auth)

5105 RADIATION TREATMENT OF TEXTILE DYE WASTES. Craft, T. F.; Eichholz, G. G. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 15: No. 2, 719-20(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5106 IONIC REACTIONS IN MONOSILANE. SOME RADIATION CHEMISTRY IMPLICATIONS. Yu, T. Y.; Cheng, T. M. H.; Kempter, C. V.; Lampe, F. W. (Pennsylvania State Univ., University Park). Contract AT(11-1)-3416. J. Phys. Chem.; 76: No. 23: 3321-30(9 Nov 1972).

The ion-molecule reactions occurring in ionized monosilane were studied by high-pressure mass spectrometry up to about 0.5 Torr and by tandem mass spectrometry in both 90 and 180° configurations. Relative cross sections of the second-order primary ion and secondary ion reactions were determined at relative kinetic energies of reactants near 1 eV. Rate constants of both second- and third-order primary ion reactions were also measured. It is suggested that $Si_2H_7^+$, $Si_3H_9^+$, and $Si_4H_{11}^+$, whose abundance reaches 35% of the ions present, are responsible for the large yield of disilane in the radical-scavenged radiolysis. (auth)

5107 MECHANISMS OF PHOTOBLEACHING OF TRAPPED ELECTRONS IN ETHYLENE GLYCOL–WATER GLASS. Steen, H. B.; Moan, Johan (Norsk Hydro's Inst. for Cancer Research, Oslo). J. Phys. Chem.; 76: No. 23: 3366-72(9 Nov 1972).

The mechanisms of excitation and photobleaching of radioinduced trapped electrons, e_t^-, were investigated by studying the effect of electron scavengers on the photobleaching of e_t^- in equivolume ethylene glycol-water glass. OD at λ_{max}(i.e., at 585 nm) was measured during x irradiation and subsequent exposure to monochromatic light of various wavelengths λ_b. The photobleaching quantum yield, ϕ, decreased by a factor of about 15 between 366 and 546

nm, while above 546 nm it was constant. The presence of NO_3^- enhanced ϕ significantly. This effect decreased with increasing λ_b. e_t^- appeared to exhibit a number of excited levels some of which were below the ionization potential E_i. Thus, the lowest excited level seemed to be at about 1.8 whereas $E_i = (2.4 \pm 0.2)$ eV. The results were in accordance with the assumption that the photoactivation of e_t^- occurs via excited states of e_t^- located above E_i, whereas the direct transition of e_t^- to the conduction band seemed to be insignificant. The excited states of e_t^-, both below and above E_i, may react with the solvent glass, i.e., with ethylene glycol, as well as with solute molecules. (auth)

5108 ELECTRON SPIN RESONANCE STUDY OF NITRILE AND OTHER RADICALS TRAPPED IN γ-IRRADIATED SINGLE CRYSTALS OF CYANOACETIC ACID. Toriyama, K.; Lin, W. C. (Univ. of British Columbia, Vancouver). J. Phys. Chem.; 76: No. 23: 3377-84(9 Nov 1972).

Single crystals of cyanoacetic acid were irradiated with γ rays at 77°K and studied by ESR spectroscopy at various temperatures. A radical with a nitrogen coupling and a large proton coupling was found. This was interpreted as the nitrile radical, $NCHCH_2COOH$. The g and the hyperfine coupling tensors were determined: $g_1 = 2.0021$, $g_2 = 2.0027$, $g_3 = 2.0057$, $A_1^N = 37.0$ G, $A_2^N = 2.9$ G, $A_3^N = 6.3$ G, $A_1^H = 93.7$ G, $A_2^H = 89.6$ G, $A_3^H = 88.0$ G. Besides the nitrile radical, an anion radical, a radical of the formula $NCCH_2\cdot$, and a π radical, NCĊHCOOH, were also observed. The nitrile radical was thought to be formed from the anion radical in a postradiation process. (auth)

5109 ELECTRON SPIN RESONANCE OF O_3^- TRAPPED IN $Ba(ClO_3)_2 \cdot H_2O$ SINGLE CRYSTALS. Suryanarayana, D.; Sobhanadri, J. (Indian Inst. of Tech., Madras). Solid State Commun.; 11: No. 10, 1467-9(15 Nov 1972).

O_3^- was trapped as an isolated paramagnetic center after uv photolysis of an x-irradiated single crystal of $Ba(ClO_3)_2 \cdot H_2O$. The ESR spectrum showed that there are two magnetically inequivalent sites and the principal g values are obtained as 2.0146, 2.0098, and 2.0017 with an average value of 2.0087. The optical absorption band at 435 mμ is strongly polarized along the [001] direction. (auth)

5110 NATURE OF PARAMAGNETIC CENTRES IN CYSTEINE HCl SINGLE CRYSTAL IRRADIATED AT 77°K. Kayushin, L. P.; Krivenko, V. G.; Pulatova, M. K. (Inst. of Biological Physics, Moscow). Stud. Biophys.; 33: No. 1, 59-66(1972).

Electron spin resonance absorption was observed in single crystals of cysteine · HCl irradiated at 77°K. The principal paramagnetic species observed at low temperature are $(RSH)^-$, (RS^+H), and $CH_2-CH(NH_3Cl)COOH$. Further irradiation with light at 77°K using longer wavelengths (350 to 450 nm) cause the transformation of the paramagnetic centers and induce the formation of the radical $CH_2-CH(NH_3-Cl)COOH$. The warming of the crystal from 77 to 290°K produced ESR absorptions, corresponding to two radicals, having the unpaired electron localized as sulfur. The study of the electronic structure of radicals from cysteine · HCl single crystals was made by a molecular orbital extended Hückel theory. (auth)

5111 STUDIES ON THE RADIATION-INDUCED DEGRADATION AND RADICALS OF AMYLOSE FOR THE GRAFT COPOLYMERIZATION BY ELECTRON ACCELERATOR. Handa, Takashi (Science Univ. of Tokyo); Otsuka, Nobuyoshi; Ayukawa, Yaichi. Nippon Nogeikagaku Kaishi; 46: No. 1, 9-15(Jan 1972). (In Japanese).

Studies were pursued on the radioinduced degradation of amylose and radioinduced radicals as graft-point for the copolymerization in order to identify the increase in the grafted synthetic chain in the composites. ESR patterns of irradiated amylose at liquid nitrogen temperature were subjected to stepwise decay at increasing temperatures and finally illustrated similar patterns to those of glucose as the monomer unit. Apparent G values of main chain degradation and induced radical formation are estimated to be ca 2.7 and 0.1, respectively. Main chain degradation is suggested to be conducted by the hydrolysis of solvated ions. The scission is suggested to be conducted in the spur of the active site on the main chain by the comparison between number-mean and weight-mean scission numbers. It is suggested that ordered scission of the main chain is induced by the isosbestic point near D.P. 400 in the pattern of column chromatographic analysis with increasing radiation dose. The scission is thought to be induced by the energy transfer of the kinetic energy of the electrons and ions to the folded part of the crystal surface. (Japan)

5112 RADIOINDUCED POLYMERIZATION OF CAREFULLY DRIED ACRYLONITRILE. Tolstoukhova, L. P.; Bryantseva, N. V.; Sheinker, A. P.; Abkin, A. D. Vysokomol. Soedin., Ser. B; 14: No. 8, 567-8(Aug 1972). (In Russian).

Acrylonitrile was dried over $Ca(OH)_2$ and vacuum distilled at 300°C before subjecting to γ radiation at −78°C, −50°, and 0°C to induce polymerization. The polymerization rate of the dried acrylonitrile at the three temperatures was about the same, but was greatly increased by the addition of MgO. (K.S.W.)

5113 STUDY ON TRAPPED RADICALS IN IRRADIATED POLY(VINYL ALCOHOL) BY VISIBLE LIGHT ABSORPTION SPECTRUM. Yoshitake, Toshihiko; Imai, Kiyokazu; Ukida, Junji (Kuraray Co. Ltd., Okayama, Japan). Kobunshi Kagaku; 29: No. 325, 313-17(May 1972). (In Japanese).

Ultraviolet and visible light absorption spectra of thick poly (vinylalcohol)(PVA) films which were irradiated with ^{60}C γ-rays in air or N_2 atmosphere were measured. Absorption peaks at 230 and 335 mμ, shoulders at 280 and 375 mμ, and weak broad absorption bands 400 ~ 500 mμ were observed. Of these, three absorption bands at 335, 375, and 400 ~ 500 mμ disappear entirely when the irradiated PVA film was treated with water vapor at room temperature or heat-treated for a short time in air. These findings suggest that these three unstable absorption bands come from three kinds of trapped radicals produced in PVA due to irradiation. The order of the rate of production expressed by the absorption bands is $D_{335} > D_{375} > D_{400\sim500}$. Films of PVA with various crystallinities were irradiated and the decays of trapped radicals were measured. The rate of decay was more rapid in lower crystalline film and at higher temperature. The trapped radicals disappeared entirely when the irradiated films were treated in the temperature range above the glass temperature, but they decayed partially below that temperature. Percentage of remaining radical was proportional to the crystallinity of PVA. (Japan)

5114 OBSERVATION OF A TRANSITION SPECTRUM $\Delta M(s) = \pm 2$ IN NITRAMINES IRRADIATED AT 77°K USING ELECTRON SPIN RESONANCE. Darnez, C.; Cherville, J.; Delhaes, P. (Centre d'Etudes Scientifiques et Techniques d'Aquitaine, Le Barp, France). Compt. Rend., Ser. C; 275: No. 7, 391-4(16 Aug 1972). (In French).

A spectrum (g approximately equal to 4) attributed to NO_2 radical pairs was observed for the first time with nitramines irradiated at 77°K. The intensity of the spectrum increases with the dose and decreases with increasing temperature. The existence of hydrogen bonds might explain the crystal cohesion in hexagon and octagon and account for the formation and stability of these species. (France)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 4991.

Hot-Atom Chemistry

5115 AFTEREFFECTS OF THE $^{57}Co(EC)^{57}Fe$-REACTION IN SOME COBALT AND IRON COMPLEXES. Siekierska, K. E.; Fenger, J.; Olsen, J. (Danish Atomic Energy Commission, Risoe). J. Chem. Soc., Dalton Trans.; No. 18, 2020-5(1972).

Moessbauer emission spectra of iron and cobalt complexes, doped or labeled with ^{57}Co, demonstrate that the $^{57}Co(EC)^{57}Fe$ reaction can have significant chemical effects, although the probability of displacement of the nascent ^{57}Fe is very low. Measurements on specifically ^{57}Co-labeled $[Co(bipy)_3][Co(CN)_6] \cdot 2H_2O$ failed to show transfer of ^{57}Fe from one complex to the other. (auth)

5116 CHEMICAL FORMS OF ^{211}At PRODUCED IN PROCESSES OF ELECTRON CAPTURE FROM ^{211}Rn IN LIQUID HYDROCARBONS. Kuzin, V. I.; Nefedov, V. D.; Norseev, Yu. V.; (and others) (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 2, 161-3(1972).

Translated from Khim. Vys. Energ.; 6: No. 2, 181-3(1972).

Chemical forms of ^{211}At, produced in processes of electron capture from ^{211}Rn in such media as n-pentane, n-hexane, cyclopentane, cyclohexane, and benzene, were studied. Values are tabulated showing distribution of ^{211}At among various alkyl astatides. Only 74% of the ^{211}Rn is transformed by electron capture; in 26% of the cases, it disintegrated by α-emission with the formation of ^{207}Po. Thin-layer chromatographic study shows that all of the ^{207}Po is stabilized in inorganic forms. (D.H.M.)

5117 CHEMICAL CONSEQUENCES OF THERMAL ANNEALING IN NEUTRON ACTIVATED THIOANTIMONY COMPOUNDS. Facetti, J. F.; Vallejos, A. (Univ., Asuncion). J. Inorg. Nucl. Chem.; 34: No. 12, 3659-64(Dec 1972).

Thermal annealing patterns of some neutron-irradiated thioantimony compounds suggest that the trapping of metastable species is determined in part by the matrix of the compound, and that the

stabilization of the higher oxidation state is related to the sulphur atom content and the covalent character of the Sb–S bond. Internal conversion accounts for the primary oxidation of the recoil atoms. (auth)

5118 TRANSPORT OF ^{131}Te IN A FLOW OF CHLORINE–OXYGEN. Steinwandter, H. (Technische Univ., Darmstadt, Ger.). Inorg. Nucl. Chem. Lett.; 8: No. 12, 1047-52(Dec 1972).

Of the recoil atoms from a ^{252}Cf source, the transport behavior of ^{131}Te in the gas phase was investigated. The transport gas used was N_2; the reaction gases were Cl_2 and a $Cl_2–O_2$ mixture. Using the kinetic theory of gases a model of the chlorination and oxidation of ^{131}Te is discussed. This indicates that the average rate constant for chlorination is ten times that for oxidation. (auth)

5119 REACTIONS OF ^{18}F ATOMS WITH ETHYLENE. Williams, R. L.; Rowland, F. S. (Univ. of California, Irvine). Contract AT(04-3)-34. J. Phys. Chem.; 76: No. 24, 3509-17(23 Nov 1972).

Energetic ^{18}F atoms formed by the $^{19}F(n,2n)^{18}F$ nuclear reaction can undergo both hot and thermal addition reactions with ethylene to form excited $CH_2{}^{18}FCH_2{}^*$ radicals. The hot reactions of ^{18}F can be almost entirely suppressed by moderation with SF_6 or CF_4, and the excited $CH_2{}^{18}FCH_2{}^*$ radicals exhibit normal stabilization–decomposition (to $CH^{18}F = CH_2 + H$) behavior vs. pressure for monoenergetically excited radicals. The stabilized radicals are observed as $CH_3CH_2{}^{18}F$ after reaction with scavenger HI. The half-stabilization pressures for SF_6 and CF_4 are 80 and 135 Torr, respectively, and are essentially unchanged for moderator fractions >0.75. The difference in half-stabilization pressures indicates that SF_6 is more efficient, per molecule, in removing the excitation energy of $CH_2{}^{18}FCH_2{}^*$ radicals. In less-moderated systems, hot reactions are also observed: (a) the formation of $CH^{18}F = CH_2$ by a more energetic route; (b) the formation of $CH^{18}F$ from secondary decomposition of $CH^{18}F = CH_2$; and (c) the formation of $CH_2{}^{18}F$ by decomposition of $CH_2{}^{18}FCH_2{}^*$. The rupture of the C–C bond in $CH_2{}^{18}FCH_2{}^*$ probably occurs predominantly after capture of ^{18}F at high-impact parameters with consequent high-angular momentum in the excited radical. Similarly, substitution of $^{18}F/H$ at high-impact parameters is postulated to lead to the C=C bond rupture in $CH^{18}F = CH_2{}^*$. (auth)

5120 PART I. KINETIC THEORY APPLICATIONS TO HALOGEN HOT ATOMS ACTIVATED BY RADIATIVE NEUTRON CAPTURE IN METHANE, DEUTERATED METHANE, AND POLYHALOMETHANES. PART II. APPLICATION OF RADIOMETRIC TECHNIQUES IN THE ANALYSIS OF SERUM AND TISSUE PROTEIN. Yoong, Matthias Jung Chung. Lincoln, Neb.; Univ. of Nebraska (1972). 131p. University Microfilms Order No. 72-27,441.

Thesis.

PART I. The reactions of (n,γ)-activated and (I.T.)-induced ^{130}I in gaseous CH_4 and CD_4 were compared. The experimental results showed that the hot organic (n,γ) yield was consistently higher than the hot organic (I.T.) yield. It was concluded that the (n,γ) yield occurred by virtue of kinetic energy imparted to the recoil iodine atoms or ions as a result of gamma-ray cascades, and the (I.T.) yield occurred by virtue of kinetic energy acquired following coulombic repulsion due to Auger electron cascades. It was also determined in a systematic study of (n,γ)-activated ^{128}I with a series of halomethanes, CH_3F, CH_3Cl, CH_3Br, and CH_3I, that the formation of ^{128}I-labeled organic products (mainly ^{128}I for halogen substitutions) proceeds entirely by "hot" reactions requiring excess kinetic energy to occur. This is unlike the reactions of (n,γ)-activated ^{128}I with CH_4 or CD_4 where the hot organic product $CH_3{}^{128}I$ was formed not only by hot ^{128}I atoms or ions but also by thermal ion-molecule reactions involving ions that are translationally thermalized and electronically excited, especially I^+ in $^1D_2$, $^3P_0$, $^3P_1$, and $^3P_2$ states. The limiting hot ^{128}I organic yields in gaseous CH_4, CH_3F, CH_3Cl, CH_3Br, and CH_3I are 18.5 ± 2.0%, 11.2 ± 1.0%, 4.2 ± 0.5%, 0.67 ± 0.1%, 0.20 ± 0.1% respectively. It was found that the progressive linear-decrease in hot ^{128}I organic yields in halomethanes was dependent on the halomethane's system' energy-degradation factors. PART II. Part II deals with the radiometric analysis of serum and tissue proteins. The radiometric method that was developed has been found to be superior to the previous biuret methods in that the effects of interferences are minimized, the sensitivity is increased, and the linear range of determination of protein concentration is extended. (TSS) (Diss. Abstr. Int., B)

5121 ENERGY NONRANDOMIZED DECOMPOSITION IN SPIROPENTANE INITIATED BY RECOIL TRITIUM SUBSTITUTION REACTIONS. Tang, Y. N.; Su, Y. Y. (Texas A and M Univ., College Station). J. Chem. Phys.; 57: No. 9, 4048-9 (1 Nov 1972).

A parallel confirmation of Rynbrandt and Rabinovitch's findings about energy nonrandomized decomposition with a spiropentane system excited by the recoil tritium substitution reaction is reported. The C_3H_3T/C_2H_3T ratio decreased with increasing pressure. (M.C.G.)

5122 RADIOCHEMICAL STUDIES ON INORGANIC AND ORGANOMETALLIC COMPOUNDS BY RADIO GAS CHROMATOGRAPHY. Tominaga, T. (Tokyo Univ.). Bunseki Kiki; 10: No. 2, 88-94(Feb 1972). (In Japanese).

Recent works on the application of gas chromatography to organometallic and inorganic compounds, particularly on radiochemistry of those compounds by radio gas chromatography are reviewed. The production of labeled compounds by a hot atom reaction of inorganic halogenides systems and the exchange reaction in those systems with radioisotopes are dealt with as typical examples of the application study to inorganic compounds. Studies of the separation of ^{82}Br labeled compounds formed by hot neutron irradiation of CF_3Br, CF_2Cl_2, $CFCl_3$ and Br system are introduced in detail with regard to the techniques using radio gas chromatography and to equipment. As to the application to organic compounds, other radio gas chromatographic studies on the labeled compounds obtained by the hot atom reaction of tetramethyl compounds of Si, G, Sn with recoil tritium are described. Hot atom reaction in organometallic compound ($(C_2H_3)_4G$) systems is also mentioned. (Kobatake, H.) (Japan)

5123 RECOIL AND CHARGING CONTRIBUTIONS TO ORGANIC INCORPORATION OF RADIOBROMINE ATOMS FOLLOWING NEUTRON ACTIVATION. Collins, K. E.; Robinson, G. D. Jr., Collins, C. H. (State Univ. of New York, Buffalo). J. Phys. Chem.; 76: No. 23, 3331-6(9 Nov 1972).

Radiobromine atoms from n, γ activation events in bromine-carbon tetrachloride solutions appear to form carbon-bromine bonds solely as a result of electronic processes initiated by the inner-shell vacancies, which accompany internal conversion. Organic yield data from the n, γ reactions were used to evaluate the probabilities of internal conversion accompanying these nuclear activations. A general notation relating certain nuclear factors that may influence the chemical fate of transformed atoms is introduced. (auth)

5124 REACTIONS OF PHOTOCHEMICALLY PRODUCED HYDROGEN ATOMS AT ENERGIES BELOW 1.8 ELECTRON VOLTS. Hong, K. Y.; Mains, G. J. (Univ. of Detroit). J. Phys. Chem.; 76: No. 23: 3337-42(9 Nov 1972).

The addition of I_2 to HI–RD photolysis systems at 40° unambiguously differentiates between products that arise by reaction of hot H atoms and those of thermal H atoms by efficiently removing the latter. Hot H atoms, formed with maximum initial energy of 1.8 eV by photolysis of HI at 253.7 nm, were found to preferentially abstract hydrogen over deuterium from partially deuterated ethanes by a factor of 5 to 8. SiD_4, Si_2D_6, and CH_3SiD_3 were also studied and found to be much more reactive than their carbon analogs. Comparison of this research at very low total pressures, ca. 2 Torr, with earlier research on these systems in the hundred Torr region, showed that the ratio of the probability of moderation to reaction was pressure independent for the perdeuteriohydrocarbons and partially deuterated ethanes studied. (auth)

5125 REACTIONS OF IODINE WITH OLEFINS. III. RADIATIVE NEUTRON CAPTURE INDUCED REACTIONS OF ^{128}I WITH GASEOUS ETHYLENE AND PROPYLENE. Pettijohn, R. R.; Rack, E. P. (Univ. of Nebraska, Lincoln). J. Phys. Chem.; 76: No. 23: 3342-8(9 Nov 1972).

Reactions of (n,γ) activated ^{128}I with gaseous ethylene and propylene were studied. The total organic product yields were found to be 18 ± 1 and 24 ± 2%, respectively. In both studies $CH_3{}^{128}I$ was found to be the predominant product. Gas additive studies have shown that $CH_3{}^{128}I$ is stabilized in the order Xe > Kr < He. This trend, exactly opposite to that expected of kinetic energy moderation, is attributed to the ion-molecule reaction $I^+(^3P_0$ or $^3P_1) + C_2H_4 \rightarrow C_2H_4I^+$ as the initiating step in $CH_3{}^{128}I$ formation. Additional labeled products from ethylene are $C_2H_3{}^{128}I$ and $C_2H_5{}^{128}I$. The formation of $C_2H_3{}^{128}I$ is dependent on the presence of molecular iodine and appears to be due to the reaction $^{128}I_2^+ + C_2H_4 \rightarrow C_2H_3{}^{128}I^+ + HI$. The results suggest that $C_2H_5{}^{128}I$ is formed via the activated monoiodoethyl radical. $CH_3C{}^{128}I = CH_2$ from propylene is believed to be produced in an analogous way to that of $C_2H_3{}^{128}I$ from ethylene. (auth)

5126 CHEMICAL EFFECT ASSOCIATED WITH THE NUCLEAR ISOMER TRANSITION OF $CH_4-{}^{80m}BrBr$ AND $CH_4-H^{80}Br$ SYSTEMS IN THE GAS PHASE. 2. Yagi, M. (Tohoku Univ., Sendai); Kondo, K.; Kobayashi, T. Kakuriken Kenkyu Hokoku; 4: No. 1, 102-8(Sep 1971). (In Japanese).

The nuclear isomeric transitions of ^{82}Br in $CH_4-{}^{82}BrBr$ and $CH_3Br-{}^{82m}BrBr$ systems cause effects on the kinetic energy of

the atom due to the coulomb repulsion caused by the internal conversion electrons, and have effects on the organic yield. An experiment was carried out in order to investigate the contributions of the kinetic energy of the atoms and of charges, and to know the recombination process of ^{80}Br in $CH_4-{}^{80m}BrBr$ and $CH_4-H^{80m}Br$ systems. The organic yields of the systems were obtained by analyzing the decay curve. The production yields were obtained by measuring the relative intensities of the activities of separated layers by gas chromatography. Contribution of the charge to the yield was separated from the contribution of the kinetic energy which was suppressed by adding reduction material. The yield of $CH_3{}^{80}Br$ was greatly reduced by the addition of the moderating material Kr, while the yield of $CH_2{}^{80}BrBr$ was not reduced but increased at above 0.6 mf Kr. In the $CH_4-H^{80m}Br$ system, effects of the moderating material Kr on the yield were not observed. Mechanism of production of $CH_3{}^{80}Br$ and $CH_2{}^{80}BrBr$ and the Estrup–Wolfgang model concerning the recombination reaction were discussed. (Japan)

Properties of Radioactive Materials

5127 H-NMR STUDY OF THE MOLECULAR STRUCTURE AND CONFORMATIONAL MOBILITY OF PARAMAGNETIC ORGANOMETALLIC ALKOXY-URANIUM(IV) COMPLEXES: TRIS(CYCLOPENTADIENYL)-n-HEXYLOXY-, -CYCLOHEXYLOXY-, AND -CHOLESTERYLOXY-URANIUM(IV). von Ammon, Reinhard; Fischer, R. Dieter; Kanellakopulos, Basil (Kernforschungszentrum, Karlsruhe, Ger.). Chem. Ber.; 105: 45-62(Jan 1972). (In German). (KFK–1559).

The properties, particularly the ^1H NMR spectra of three organometallic complexes $(C_5H_5)_3UOR$ with R = n-hexyl-, cyclohexyl-, and cholesteryl- are described. The large paramagnetic shifts in the ^1H NMR spectra induced by the U(IV) ion give rise to discrete signals for each CH_2 and CH_3 group of the open chain substituent as well as for each single proton of the cyclohexane and the cholesterol ring A. In the rigid cholesterol complex the signals can be assigned by comparing their paramagnetic shifts with the geomagnetic factors of the protons as determined from a molecular model. Thence it is concluded that the shifts of all protons except the α-protons are of the pseudocontact type. The U–O–C group appears to be strongly bent, thus inhibiting the rotation around the O–C-axis in the cholesterol complex. The paramagnetic shifts of the α-protons of all three complexes can only be accounted for by assuming an additional Fermi contact contribution of the same (negative) sign as the pseudocontact shift. The ring inversion of the C_6H_{11} ring in the cyclohexyl complex also is strongly hindered, with a lower limit for the ΔG° value of 2.3 kcal/mole. (auth)

5128 POLAROGRAPHIC STUDY ON THE KINETICS OF FORMATION AND DECAY OF SEVERAL SPECIES IN SOLUTIONS OF RADIOACTIVE IODINE COMPOUNDS OF HIGH ACTIVITY. Zagorski, Z. P.; Kulesza, A. (Inst. of Nuclear Research, Warsaw). Chem. Anal. (Warsaw); 17: No. 4, 1107-11(1972).

The polarographic method was applied to the investigation of phenomena induced by radiation from radioactive iodine. The following substances were determined: iodides by the anodic wave, oxygen by using the first reduction wave, hydrogen peroxide, together with the second oxygen wave, and iodates at the most reducing potential. (auth)

5129 INFRARED SPECTRUM OF UF_6. Bar-Ziv, E.; Freiberg, M.; Weiss, S. (Israel Atomic Energy Commission, Beersheba). Spectrochim. Acta, Part A; 28: No. 11, 2025-8(Nov 1972).

The ir spectrum of UF_6 between 350 and 2000 cm^{-1} was observed under high resolution and using long optical paths. Several previously unresolved or poorly resolved bands were resolved to show their P, Q, R structures. All bands were assigned and the calculated frequencies of the combination bands found to be in good agreement with the experimental ones. (auth)

5130 SULFITE COMPLEXES OF NEPTUNIUM(V). Blokhin, V. I.; Bukhtiyarova, T. N.; Krot, N. N.; Gel'man, A. D. (Inst. of Physical Chemistry, Moscow). Zh. Neorg. Khim.; 17: No. 9, 2420-5(Sep 1972). (In Russian).

Complex formation of Np(V) with sulfite ions was studied by preparative and spectrophotometric methods. The neptunyl ion in neutral solutions forms the two complexes $NpO_2SO_3^-$ and $NpO_2(SO_3)_2^{3-}$. Their stepwise stability constants at 25°C and at an ion strength u = 1.0 are, respectively, $K_1 = 4 \times 10^2$ and $K_2 = 10$. The following compounds were isolated as solids and analyzed: $NaNpO_2SO_3 \cdot H_2O$; $NaNpO_2SO_3 \cdot 2H_2O$; $NH_4NpO_2SO_3$; $KNpO_2SO_3$; and $Co(NH_3)_6NpO_2(SO_3)_2 \cdot nH_2O$. (tr-auth)

5131 BINARY SYSTEMS CONTAINING $MgCl_2$, $CaCl_2$, AND UF_4. Desyatnik, V. N.; Katushev, C. F.; Pasropin, S. P.; Trifonov, I. I. (Ural Polytechnic Inst., Sverdlovsk, USSR). Zh. Neorg. Khim.; 17: No. 9, 2546-8(Sep 1972). (In Russian).

The two binary systems $MgCl_2-UF_4$ and $CaCl_2-UF_4$ were investigated by differential thermal and roentgen analyses. The $MgCl_2-UF_4$ system formed two eutectics (20 mole% UF_4 melting at 620°C, and 50 mole% melting at 610°C), and the two compounds: $3MgCl_2 \cdot 2UF_4$ and $MgCl_2 \cdot 7UF_4$. The $CaCl_2-UF_4$ system formed two eutectics (16.5 mole% UF_4 melting at 635°C and 47 mole% melting at 560°C), and one congruently melting compound, $2CaCl_2 \cdot UF_4$. (K.S.W.)

5132 HYDRATES OF URANYL FLUORIDE. Seleznev, V. P.; Vetkov, A. A. Sudarikov, B. N.; Gromov, B. V. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim.; 17: No. 9, 2587-9(Sep 1972). (In Russian).

Four hydrates of UO_2F_2 were synthesized and x ray measurements were taken. Solid solutions could be formed from the mono- and di-hydrates, and similarly from the tri- and tetrahydrates. (tr-auth)

5133 IMPROVEMENT TO TECHNIQUES FOR MANUFACTURING URANIUM TETRAFLUORIDE. Muller, J.; Lorrain, C.; Vertes, P. (to Commissariat a l'Energie Atomique). French Patent 2,101,082. 31 Mar 1972. Filed 19 Aug 1970. (In French).

This process for manufacturing UF_4 consists of reducing higher oxides of uranium to UO_2 with ammonia gas and fluorinating the UO_2 with hydrofluoric acid. The UO_2 is simultaneously reacted with ammonia gas and hydrofluoric acid at a temperature where the decomposing ammonia gas favors the reaction between the hydrofluoric acid and the UO_2. The apparatus is provided with a furnace for reducing the higher oxides of uranium to UO_2, a furnace for the fluorinating of the UO_2, and a cooling device interposed between the two furnaces. (France)

5134 SEARCH FOR LASER PHENOMENA IN THE ACTINIDES. STUDIES OF INVESTIGATIONS OF Am^{3+} IN LIQUID $POCl_3$. Friedman, H. A.; Bell, J. T. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 34: No. 12, 3928-30(Dec 1972).

The potentialities of Am^{3+} as a laser activator ion in a $POCl_3$ solution were investigated. All attempts to produce a trivalent ^{243}Am laser were unsuccessful. Possible reasons for the failure are: (1) the chemistry of the liquid medium was not perfected (However, since the same process was successful for the Nd^{3+} laser, it is not likely the reason that Am^{3+} did not lase.); (2) the lifetime of the excited state of Am^{3+} was not adequate and can be considered to be an intrinsic property of Am^{3+}; (3) the excited-state level of Am^{3+}, as represented by the 5030-Å absorption band, could possibly act as a subground-state level from which higher excited-state levels could be populated. Although Am^{3+} in the $POCl_3$ or $CaWO_4$ matrix showed no laser activity, it is still possible that some form of Am^{3+} will lase in another matrix. This reasoning appears to be valid because europium exhibits no laser activity in some media at room temperature whereas europium chelates have been shown to lase. (auth)

5135 DOUBLE LAYER EFFECT ON THE ELECTRODE KINETIC REDUCTION OF Pu(IV) CARBONATE COMPLEXES IN AQUEOUS SOLUTION. Casadio, S.; Orlandini, F. (Comitato Nazionale per l'Energia Nucleare, Casaccia, Italy). J. Inorg. Nucl. Chem.; 34: No. 12, 3845-9(Dec 1972).

The influence of double layer structure on the kinetic parameters for the Pu(IV) + e = Pu(III) charge transfer in carbonate media is consistent with anionic depolarizing species associated with supporting cations (ion pairs) in the increasing order Na^+, K^+ and Cs^+, whose specific adsorption at the mercury electrode, increasing in the same way, could explain the observed variations in transfer coefficient with the nature of the supporting cation. (auth)

5136 NON-POISSON DISTRIBUTIONS OBSERVED DURING COUNTING OF CERTAIN ^{14}C-LABELED ORGANIC (SUB)MONOLAYERS. Anderson, J. L. J. Phys. Chem.; 76: No. 24, 3603-12(23 Nov 1972).

As shown by the index of dispersion statistic s^2/m, anomalous narrow statistical distributions were consistently obtained from counts of β radiation emitted by adsorbed, high specific activity ^{14}C-labeled organic (sub)monolayers (1) when first-order desorptions from metal oxide surfaces occur, (2) when adsorbed stearic acid-1-^{14}C on certain nongrounded surfaces is counted, and (3) when aluminum foil containing such stearic acid-1-^{14}C is charged at a positive potential (e.g., 90 V positive with respect to an adjacent, grounded aluminum "window") for sequential periods of up to 450 min. The markedly low variances, observed with external detectors, were in contrast to "normal" or Poisson-expected values which were invariably obtained using the same equipment when the surfaces had either nonadsorbed radiochemicals or nonevaporating radiochemicals under grounded or negative

polarity conditions. Based on a number of individual experiments involving several different counting systems and detectors and representing several thousands of degrees of freedom, the radioactive decay process observed under these certain conditions is not properly described by the Poisson distribution. The inconsistency of this phenomenon with known and generally accepted theories of radioactive decay raises serious questions relative to the generality of the independence of radioactive decay events and/or the randomness of emissions. (auth)

5137 EFFECT OF CERTAIN METAL OXIDES ON THE ACTIVITY AND SELECTIVITY OF Co CATALYSTS IN THE SYNTHESIS OF HIGHER HYDROCARBONS FROM CO AND H_2. Eidus, Ya. T.; Bulanova, T. F. (Inst. of Organic Chemistry, Moscow). Kinet. Katal.; 13: No. 2, 507-9(1972). (In Russian).

Two series of catalysts were prepared for the synthesis of hydrocarbons from CO and H_2 at atmospheric pressure and 190 to 200°C. In one of the series prepared the ratio is 100 Co: 18 M_mO_n: 100 kieselguhr. In the second series the ratio is 100 Co: 10 M_mO_n: 6 MgO: 200 kieselguhr. The following Group 4B oxides and rare earth oxides functioned as the additive M_mO_n in these series of catalysts: TiO_2, ZrO_2, HfO_2, ThO_2, CeO_2, Y_2O_3, La_2O_3, and Nd_2O_3. In the first series, the catalyst additives were rated on the basis of activity: $HfO_2 > TiO_2 > ThO_2 > ZrO_2$; on the basis of selectivity: TiO_2, $ZrO_2 > ThO_2 > HfO_2$. In the second series, the catalyst additives were rated on the basis of activity at 200°C: $ThO_2 > TiO_2 > ZrO_2 > CeO_2 > Nd_2O_3$; on the basis of the selectivity at 190°C: $Nd_2O_3 > ZrO_2 > ThO_2 > CeO_2 > La_2O_3$. Similar data were given at other temperatures. (K.S.W.)

5138 X-RAY INVESTIGATION OF TETRAHYDRATES OF Co, Ni, Zn, AND Mn TETRAFLUORODIOXOURANATES. Udovenko, A. A.; Mikhailov, Yu. N.; Davidovich, R. L.; Kuznetsov, V. G. (Inst. of Chemistry, Vladivostok, USSR). Zh. Neorg. Khim.; 17: No. 10, 2746-51(Oct 1972). (In Russian).

The series of compounds $M^{II}UO_2F_4 \cdot 4\,H_2O$ (M = Co, Ni, Zn, Mn) was investigated by means of x ray diffraction, establishing the presence of iso-structural compounds of Co, Ni, and Zn. The symmetry and parameters of the elementary cell were measured, and these data were arranged in tabular form as an aid in the future identification of these compounds. (tr-auth)

5139 SPECTROPHOTOMETRIC STUDIES OF URANIUM(VI) COMPLEX WITH 3-PHENYL-4,5,7-TRIHYDROXYCOUMARIN. Dhar, M. L.; Jain, A. C. (Univ. of Jammu, India). Curr. Sci. (India); 41: No. 22, 809-10(20 Nov 1972).

A spectrophotometric study was made of the orange-red complex formed by uranium(VI) and 3-phenyl-4,5,7-trihydroxycoumarin in ethanol. Results show that the molar ratio of U(VI) and ligand is 1 : 1. (D.H.M.)

5140 ABSORPTION SPECTRA OF INEQUIVALENT SITES OF TETRAVALENT ^{237}Np IN $[(C_2H_5)_4N]_2NpCl_6$. Menzel, E. R. (Simon Fraser Univ., Burnaby, B. C.); Gruber, J. B.; Ryan, J. L. J. Chem. Phys.; 57: No. 10, 4287-90(15 Nov 1972).

The optical absorption spectrum of single crystal $[(C_2H_5)_4N]_2NpCl_6$ was examined. Between 300 and 77°K the spectrum can be understood in terms of the analysis made recently for Cs_2NpCl_6 since many aspects of the $NpCl_6$ complex spectrum are similar. At 4°K, however, the spectrum shows evidence for two inequivalent sites of Np^{4+}. The octahedral ground state Γ_8 is split by 14 cm^{-1} in one site and by 16.5 cm^{-1} in the other site. The reason for occurrence of inequivalent sites in the salt is attributed to Jahn–Teller instability coupled with the presence of the large organic complex cation $[(C_2H_5)_4N]^+$. (auth)

5141 LANTHANIDES AND ACTINIDES. Bagnall, K. W. (ed.). MTP International Review of Science. Inorganic Chemistry, Series One, Volume 7. Baltimore; University Park Press (1972). 375p.

Each of the nine chapters was abstracted separately for NSA. (J.G.B.)

For abstracts of individual chapters see: 5011, 5012, and 5142–5148.

5142 LANTHANIDE AND ACTINIDE MIXED OXIDE SYSTEMS WITH ALKALI AND ALKLAINE EARTH METALS. Keller, C. (Inst. for Radiochemistry, Karlsruhe, Ger.). pp 47-85 of Lanthanides and Actinides. /Bagnall, K. W. (ed.). Baltimore; University Park Press (1972).

The review on mixed oxides is presented in two parts. The first is a discussion of compounds formed by reactions of monovalent alkali and alkaline earth metal oxides with heptavalent, hexavalent, and pentavalent actinides and with tetravalent and trivalent actinide and lanthanide elements. The second part consists of a discussion of compounds formed by reactions of divalent alkali and alkaline earth metal oxides with heptavalent, hexavalent, and pentavalent actinides and with tetravalent and trivalent actinide and lanthanide elements. (164 references) (J.G.B.)

5143 ACTINIDE HALIDES AND THEIR COMPLEXES. Brown, D. (Atomic Energy Research Establishment, Harwell, Eng.). pp 87-137 of Lanthanides and Actinides. /Bagnall, K. W. (ed.). Baltimore; University Park Press (1972).

Publications from 1967 to mid-1970 on actinide halides and their complexes are reviewed. The compounds are discussed in order of decreasing valence state and increasing atomic number of both actinide element and halogen. Compounds discussed are halides, oxyhalides, halogeno-complexes, oxyhalogeno-complexes, and halide and oxyhalide complexes with donor ligands. (266 references) (J.G.B.)

5144 COMPLEXES OF THE ACTINIDE CYANIDES AND THIOCYANATES. Bagnall, K. W. (Univ. of Manchester, Eng.). pp 139-56 of Lanthanides and Actinides. /Bagnall, K. W. (ed.). Baltimore; University Park Press (1972).

Chemical research on actinide cyanides is reviewed briefly. The chemistry of actinide thiocyanates is discussed under the following headings: hydrates of thorium(IV) and uranyl(VI) thiocyanates, amide complexes, urea complexes of uranyl(VI) thiocyanate, antipyrine complex of uranyl(VI) thiocyanate, tetrahydrofuran and furfural complexes, quinoline N-oxide complex of uranyl(VI) thiocyanate, phosphine and arsine oxide complexes, dimethyl sulfoxide complex of uranyl(VI) thiocyanate, complexes with nitrogen donor ligands, and anionic thiocyanato complexes. (39 references) (J.G.B.)

5145 THERMODYNAMIC PROPERTIES OF SIMPLE ACTINIDE COMPOUNDS. Fuger, J. (Univ., Liege). pp 157-210 of Lanthanides and Actinides. /Bagnall, K. W. (ed.). Baltimore; University Park Press (1972).

Thermodynamic properties of Th, Pa, U, Np, Pu, Am, and Cm ions in solution and those of halides, oxyhalides, and related actinide compounds are reviewed. Actinide oxides, sulfides, selenides, nitrides, phosphides, and carbides are discussed from the standpoint of heat capacity, entropy, and thermodynamics of formation. Emphasis is placed on those compounds of thorium and uranium. (241 references) (J.G.B.)

5146 ACTINIDE CHALCOGENIDES AND PNICTIDES. Dell, R. M.; Bridger, N. J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 211-74 of Lanthanides and Actinides. /Bagnall, K. W. (ed.). Baltimore; University Park Press (1972).

General preparative procedures are reviewed as to method, degradation, oxygen impurities, single crystal growing, and general analytical procedures. The preparation, crystal chemistry, and stoichiometry of the chalcogenides and pnictides of thorium, uranium, plutonium, and other actinides are discussed. Chemical, magnetic, and electrical properties of thorium, uranium, and plutonium compounds are discussed. Certain ternary systems, both mixed cation and mixed anion are also discussed. (255 references) (J.G.B.)

5147 ORGANOMETALLIC CHEMISTRY OF THE LANTHANIDES AND ACTINIDES. Kanellakopulos, Basil (Institut fuer Heisse Chemie, Karlsruhe, Ger.); Bagnall, K. W. pp 299-322 of Lanthanides and Actinides. /Bagnall, K. W. (ed.). Baltimore; University Park Press (1972).

Cyclopentadienyl compounds of actinides and lanthanides are discussed from the standpoint of preparation, physical and chemical properties, NMR, mass, ir, and absorption spectra, x-ray investigations, magnetic susceptibility data, and thermodynamic and other data. The chemistry of allyl, indenyl, and cyclooctatetraenyl compounds is reviewed briefly. (83 references) (J.G.B.)

5148 ABSORPTION SPECTRA OF ACTINIDE COMPOUNDS. Ryan, J. L. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. pp 323-67 of Lanthanides and Actinides. /Bagnall, K. W. (ed.). Baltimore; University Park Press (1972).

The following topics are discussed: internal $5f^q \rightarrow 5f^q$ transitions, uranyl spectra, electron transfer spectra, $5f^q \rightarrow 5f^{q-1}$ 6d transitions, and ir and Raman spectra. (253 references) (J.G.B.)

5149 RAPID PREPARATION OF AUTOLOGOUS RADIOIODINATED FIBRINOGEN. Roberts, R. C.; Sonnentag, C. O.; Frisbie, J. H. (Marshfield Clinic Foundation for Medical Research and Education, Wis.). J. Nucl. Med.; 13: No. 11, 843-6(Nov 1972).

The preparation method described differs from others primarily by omitting refrigeration to remove any cold-insoluble material. The successful preparation of completely soluble fibrinogen adequately freed of contaminating proteins requires very gentle handling of the ammonium sulfate precipitated protein. The yield was improved by short low-speed centrifugation just sufficient to

settle the precipitate without packing and mixing the ammonium sulfate wash solution by gentle inversion of the tube. (M.C.G.)

5150 NEW BONE SCANNING AGENT: ^{99m}Tc-LABELED 1-HYDROXY-ETHYLIDENE-1, 1-DISODIUM PHOSPHONATE. Castronovo, F. P. Jr.; Callahan, R. J. (Massachusetts General Hospital, Boston). J. Nucl. Med.; 13: No. 11, 823-7 (Nov 1972).

The synthesis and quality control of 1-hydroxyethylidene-1,1-diphosphonic acid and the formulation and quality control of ^{99m}Tc salts of this acid are described. The quality control procedures involve descending paper chromatography and column chromatography. (M.C.G.)

5151 MEASUREMENT OF CELL VOLTAGE OF ThO_2–Y_2O_3 SOLID ELECTROLYTE CELLS IN THE REGION OF MIXED CONDUCTION. Reetz, T. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Z. Phys. Chem. (Leipzig); 250: No. 3-4, 205-16(1972). (In German).

The decrease in cell voltages of galvanic cells with oxygen ion conducting solid electrolytes by electronic conversion can be used to determine the conversion number of an optimal reference system. The electric conduction characteristics of the solid ThO_2–Y_2O_3 electrolyte were determined from experimental studies with the cells $Pt/H_2,H_2O$(20°C saturated)/ThO_2 + 20 mole % $YO_{1.5}$/Air/Pt and Ni/Na, Na_2O(saturated)/ThO_2 + 20 mole % $YO_{1.5}/O_2$/Ag/Ni. Sources of error in determination of the average conversion number were evaluated. (tr-auth)

Radioactive Waste Treatment

Refer also to abstracts 5053, 5617, and 5759.

5152 (ARH-2458) APPLICATION OF THE HANFORD THERMITE PROCESS TO INCREASE IMMOBILIZATION OF IN-TANK SOLIDIFIED WASTE. Schulz, W. W.; Kupfer, M. J. (Atlantic Richfield Hanford Co., Richland, Wash.). Sep 1972. Contract AT(45-1)-2130. 46p. Dep. NTIS.

The Hanford Thermite process is a high-temperature process for conversion of high-level, radioactive wastes to insoluble silicates and aluminosilicates. For application of the process to Hanford's In-Tank Solidified (ITS) waste, statistically designed experiments with synthetic waste demonstrate the optimum thermite charge contains 30 to 40 wt % ITS waste, 15 to 35 wt % Fe_2O_3 (or alternatively, 15 to 35 wt % MnO_2), 15 to 20 wt % silicon metal, and 10 to 25 wt % sand. Ignition of such a charge produces a green-black silicate glass (density = ~2.5 g/cm^3; thermal conductivity = ~0.7 watt/meter °C) whose leach rate in distilled water at 25°C is in the range 10^{-7} to 10^{-5} g/cm^2 day. This glass, judging from initial data, should be an excellent vehicle for immobilization of ITS waste. (auth)

5153 HOT LABORATORY STUDY THROUGH THE EXPERIENCE OF RADIOACTIVE LIQUID WASTE TREATMENT. Masotti, E. (CNEN, Casaccia, Italy). Ing. Nucl.; 13: No. 2, 16-38(1972). (In Italian).

The problem faced when, in an already existing building, a hot laboratory for treatment of liquid radioactive wastes is needed, was studied. Technical, economic, and operational aspects as well as safety and health protection of the facility were taken into consideration, bearing in mind the particular boundary conditions. (auth)

5154 MIXED BED TREATMENT OF CONDENSATES. Treille, P. (Societe Degremont, Rueil-Malmaison, France). 16p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972). (In French).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

The methods used to regenerate the mixed bed ion exchangers used to demineralize condensates of thermal and nuclear power plants were studied. As it is necessary to filter the condensates, the installations developed are provided with a filter system and an ion exchanger system. In order to establish the behavior of the ion exchangers with regard to the mechanical stresses and the osmotic shocks to which they are subjected, an apparatus was constructed in which resin samples are alternately subjected to acid and soda treatments at relatively high pressures. Macroporous resins gave satisfactory results. The use of a mixed bed as a demineralizing element led to the external regeneration technique: a first vessel receives all the resin from the mixed bed in view of a washing treatment, separation of the cations and anions, and finally, the extraction of the anions; a second vessel receives the anions in view of their regeneration, and a third vessel reconstitutes the mixed bed. In nuclear plants, it is necessary to control the pH of the water before it enters the boiler by the injection of reagent (H_2O or NH_4OH). The effectiveness of mixed beds as demineralizers and filters is discussed. (France)

5155 TREATMENT OF CONDENSATES ON POWDERED RESIN FILTERS. Balthazar, J. 37p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972). (In French).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

The physical properties of ion exchange resins are discussed. The morphology and properties of the flakes formed by the dissolution of powdered resins in water, are presented. Powdered resin filters containing special filtering layers for treating the cation/anion exchanger resin mixtures are described. These filters contain vertical or horizontal filtering elements, which act as substrates (thin or thick) on which the thick powdered resin layers are hydraulically formed. The continuous formation of the layers on the filters enables uniform resin layers to be formed. Tests carried out in a pilot plan demonstrated that an increase in the useful ionic exchange capacity occurs when the layers are formed in this way. The effect of the pH value and the Na^+/total cations ratio on the ion exchange performance was studied. The resin layers fix a large portion of the colloidal iron corrosion products. Normally, rapid fissuration follows this process. This fissuration can be avoided by depositing a layer that selectively absorbs the colloids on top of the resin. These filters ensure purification and decontamination of radioactive waters from nuclear power plants. (France)

5156 HIGH-TEMPERATURE PROCESSES FOR IMMOBILIZATION OF HANFORD IN-TANK SOLIDIFIED WASTE. Kupfer, M. J.; Schulz, W. W. (Atlantic Richfield Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 663(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5157 TREATMENT OF ALPHA-CONTAMINATED SOLID WASTE BY ACID DIGESTION. Lerch, R. E.; Cooley, C. R.; Smith, R. C. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 665-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5158 PROCESS FOR RECOVERY OF URANIUM COMPOUNDS, AMMONIA, CARBON DIOXIDE, AND WATER. Muller, H.; Pirk, H.; Hackstein, K. G. (to Nuklear-Chemie und -Metallurgie GmbH). German Patent 2,057,966. 8 Jun 1972. (In German).

A method is described for the recovery of uranium compounds, ammonia, carbon dioxide and water and the extraction of ammonium hydrogen fluoride from NH_4^+ and CO_3^{2-} and fluorine-containing waste waters and from NH_3- and CO_2- containing waste gases, in particular from uranium-containing filtrates and waste gases from the AUC conversion. The process is thus characterized by the fact that part of the solution which has been obtained after the conversion of the waste waters (and/or waste gases) with the strongly acidic ammonium fluoride–ammonium hydrogen fluoride solution, and thus free of carbonate, is placed in a precipitation vessel without further concentration. The addition of hydrogen peroxide and ammonia forms an insoluble uranium compound. The ammonia is evaporated off as ammonium hydroxide and collected in a condenser. (GF)

5159 METHOD FOR THE TREATMENT OF RADIOACTIVE CONCENTRATES. Queiser, H.; Meichsner, O. (to Licentia Patent-Verwaltungs-GmbH). German Patent 2,035,925. 27 Jan 1972. (In German).

The method described is based on direct dehydration and drying of waste concentrates. The concentrates resulting from various waste treatments (e.g., from ion exchange resin filters, from sedimentation containers, or from other separation steps of waste processing) are mixed with each other in a certain ratio, passed through a filter provided with a suspension of cellulose fibers, and finally dried. Concentrates from the evaporation facility are dried directly in the containers used for transport and storage. (GF)

5160 METHOD FOR THE CONCENTRATION OF RADIOACTIVE WASTES. Schweigert, F.; Schroeder, P. (to Siemens AG). German Patent 1,769,911. 13 Jan 1972. (In German).

Aqueous solutions or suspensions of radioactive wastes are concentrated according to known methods, then solidified by adding a water-soluble or water-swellable plastic material which results in a gummy homogeneous substance. Subsequent drying will further shrink its volume to about 50%. In this case polyvinylalcohol was used for solidification. (GF)

Radioisotope Production

Refer also to abstract 6487.

5161 (DP-1307) DEVELOPMENT OF A PLANT-SCALE RESIN CALCINATION SYSTEM FOR PREPARING TRANSPLUTONIUM OXIDES AND OXYSULFATES. Bradley, R. F.; Burney, G. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Sep 1972. Contract AT(07-2)-1. 32p. Dep. NTIS.

A plant-scale system was developed to prepare ~100 mg batches of ^{252}Cf, or other transplutonium isotopes, as the oxysulfate or oxide without directly handling small quantities of liquid or solid. The californium is sorbed on ~50 cm^3 of cation exchange resin in a platinum column, the resin is burned away, and the column is heated to form oxysulfate at 800°C or oxide at 1250°C. The platinum column is then sealed and shipped to the user, who can dissolve and remove the product by passing nitric acid through the column. Process operating conditions and equipment requirements were first defined by tests with stainless steel columns using dysprosium as a stand-in for the transplutonium isotopes. Calcination tests were then conducted to demonstrate the process in platinum columns with terbium, ^{252}Cf, ^{242}Cm, and ^{244}Cm. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 4919, 4938, 5008, and 6888.

5162 (NBL-265, pp 28-31) DISSOLUTION OF SILICON CARBIDE-COATED URANIUM-THORIUM CARBIDE FUEL PELLETS. Hedrick, C. E. Oct 1972.

In Annual progress report for the period July 1971-June 1972.

Dissolution of silicon carbide-coated uranium-thorium carbide fuel pellets can be accomplished by fusion with a sodium carbonate-sodium chromate mixture after an ignition step to remove a graphite outer coat. (auth)

5163 (NBL-265, pp 32-3) DISSOLUTION OF SILICON CARBIDE-COATED URANIUM-THORIUM CARBIDE FUEL PELLETS: IGNITION AND SODIUM CARBONATE AND SODIUM BISULFATE FUSION PROCEDURE. Zibulsky, H.; Paller, J. S.; Siddons, T. J. Oct 1972.

In Annual progress report for the period July 1971-June 1972.

The New Brunswick Laboratory procedure for dissolving silicon carbide-coated uranium-thorium carbide fuel pellets by ignition, sodium carbonate fusion, and sodium bisulfate fusion is described. (auth)

5164 (ORNL-4782, pp 203-43) MOLTEN-SALT PROCESSING AND PREPARATION. Oct 1972.

In Molten-Salt Reactor Program.

BISMUTH—distribution between liquid lithium-bismuth alloys and molten lithium chloride, p. 207-9

EUROPIUM—solubility in liquid bismuth, p. 209

FUSED SALT—purification of, research progress on continuous, p. 241-3

LITHIUM—distribution between liquid lithium-bismuth alloys and molten lithium chloride, p. 207-9

LITHIUM ALLOYS AND SYSTEMS—Bi-Li, integral heats of solutions of, p. 209-10

MOLTEN SALT BREEDER REACTOR—fuel reprocessing for 1000 MW(e), design study and cost estimates for, p. 204-5

—fuel reprocessing for, multiregion code for flowsheet calculations from plant for, p. 205-6

PROTACTINIUM—separation from MSBR fuel salt by oxide precipitation, p. 210-12

RADIOCHEMICAL PROCESSING PLANT—economic aspects of, for MSBR fuel reprocessing, p. 204-5

RARE EARTHS—separation from MSBR fuel salt, research progress on chemical aspects of metal transfer process for, p. 207-10

REACTOR FUELS—reprocessing of molten salt, cost estimates of plant for, p. 204-5

—reprocessing of molten salt, multiregion code for flowsheet calculations for plant for, p. 205-6

—reprocessing of molten salt, engineering developments for, p. 216-40

—reprocessing of molten salt, research progress on fluorination, metal transfer, and reductive extraction process for, p. 216-40

URANIUM—separation from molten salt by reductive-extraction using bismuth, p. 227-30

—separation from MSBR fuel salt by oxide precipitation, p. 234-7

URANIUM FLUORIDES UF_6—reaction from gaseous, with uranium tetrafluoride dissolved in beryllium fluoride-lithium fluoride-thorium fluoride, p. 212-15

ZIRCONIUM—separation from molten salt by reductive-extraction using bismuth, p. 227-30. (D.H.M.)

5165 METHOD OF SEPARATING Np FROM Pu. Espie, J.-Y.; Jouan, C.; Koehly, G. (to Commissariat a l'Energie Atomique). French Patent 2,104,664. 21 Apr 1972. Filed 28 May 1970. (In French).

A process for separating Np from Pu by liquid-liquid extraction that can be used to recover ^{237}Np from effluents arising from irradiated fuel processing plants and ^{237}Np targets which have been irradiated to produce ^{238}Pu is described. The solution containing the elements to be separated is reduced and reacted with an organic phase (trilaurylamine in solution in an inert solvent) that extracts the Np(IV) but leaves the Pu(III) in the aqueous phase. The separation process consists of adding capric acid to the loaded organic phase and then washing the organic phase with an aqueous reducing solution. The solution to be treated and the aqueous washing solution bath contain a ferrous salt. (France)

5166 ACTINIDE SEPARATION PROCESS. Koehly, Gerard; de Mora, Francine (to Commissariat a l'Energie Atomique). French Patent 2,104,660. 21 Apr 1972. Filed 19 May 1970. (In French).

A method was developed for separating tetravalent actinides from hexavalent actinides. It consists of adding a complexing polyaminoacetic reagent to the solution after having adjusted the acidity of the solution to lie between 0.1N and 1N. The complexing polyaminoacetic complexes the tetravalent ions, the hexavalent ions being extracted with an organic solvent. EDTA, DTPA, or HEDTPA may be used as solvents. The method may be applied to separate uranium, plutonium, or thorium. (France)

5167 FAST REACTOR FUEL PROCESSING. Ferguson, D. E.; Lotts, A. L. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 597-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5168 DECLADDING OF STAINLESS STEEL COATED FUEL ELEMENTS BY DESTRUCTIVE OXIDATION METHOD. Markvart, M. (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 18: No. 12, 406(Dec 1972). (In Czech).

Destructive oxidation of stainless steel cladding using gaseous mixtures of hydrogen fluoride and oxygen is described. The study indicated that chemical destruction of the cladding material should be performed at concentrations between 30 and 40 vol% for the hydrogen fluoride. The most suitable pulverization of stainless steel was obtained at 560°C. During the reaction the cladding material expands (the optimal volume expansion factor is between 4 and 5). A second reaction characteristic of this highly exothermic oxidation is its self-regulating character. Metallographic analysis of the resistant products was also accomplished. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 5611, 5698, and 5713.

5169 HYDROGEN, MASTER-KEY TO THE ENERGY MARKET. Marchetti, C. (Commission of the European Communities, Ispra, Italy). Euro-Spectra; 10: No. 4, 117-29(Dec 1971).

Hydrogen is a "clean" energy medium that has not only chemical, metallurgical, and thermal uses in industry, but can be employed for cooking, heating, transport (cars, aircrafts) and even in the production of primary proteins, i.e., food. (auth)

5170 LIQUID-METAL MHD POWER CONVERSION. Cerini, D. J. JPL Quart. Tech. Rev.: 1: No. 1, 64-7(Apr 1971).

A liquid-metal magnetohydrodynamic (MHD) power converter has been successfully operated with the generation of ac electrical power. Gaseous nitrogen is used to produce the closed-cycle flow of the liquid-metal (NaK) working fluid through the MHD generator where the fluid kinetic energy is converted to electrical energy. In this article the operational characteristics of the converter are given and the results of the current series of tests are discussed. (auth)

5171 ELECTRIC FIELD IN A SEGMENTED MHD GENERATOR WITH A FINITE CONDUCTIVITY OF THE WALLS AT THE CHANNEL ENTRANCE. Nemkova, N. G. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 5, 156-65(1972). (In Russian).

The effect of a finite electric conductivity of the entrance portions on the terminal effect in a segmented MHD generator was studied. The boundary-value problem in determining electric fields in a plane duct was studied with regard to the finite conductivity of the walls in one half and of an ideal segmentation of the electrodes in the other. A similar choice of boundary conditions was induced by the peculiarities of duct design in a number of contemporary MHD arrangements. (K.S.W.)

5172 PUMPED STORAGE AND TIDAL POWER IN ENERGY SYSTEMS. Haswell, C. K. (Charles Haswell and Partners, London); Huntington, S. W.; Shaw, T. L.; Thorpe, G. R.; Westwood, I. J. J. Power Div., Amer. Soc. Civil Eng.; 98: No. PO2, 201-20(Oct 1972).

Prospects for use of pumped water storage energy and tidal energy are reviewed. Discussions are included on tidal energy, electric systems, suiting tidal power to electric systems, uniting pumped storage with tidal power, construction, and economic evaluations. (J.R.D.)

5173 ENERGY DILEMMA. Schlesinger, J. R. (Atomic Energy Commission, Washington, D. C. Oak Ridge Nat. Lab. Rev.; 5: No. 4, 8-13(1972).

Relations of public policy with energy production are discussed. The ability of the American society to deal with the energy dilemma is considered. Projections of future energy requirements are reviewed to bring in focus the problems faced by society. Discussions of several aspects of energy requirements and use are presented considering a number of viewpoints. It is noted that for reasons of national security and for time honored motives of conservation, increases in efficiency of work produced by energy are called for. (J.R.D.)

5174 MAGNETOHYDRODYNAMIC POWER: MORE EFFICIENT USE OF COAL. Hammond, A. L. Science; 178: No. 4059, 386-7(27 Oct 1972).

The technology of power production by coal-fired MHD generators is reviewed. It is noted that MHD generators offer a method of eliminating sulfur oxides and reducing nitrogen oxides emissions from coal-fired plants. Because MHD technology has not been demonstrated, its economic prospects are uncertain, but preliminary estimates are favorable. (J.R.D.)

5175 MEASUREMENTS OF PLASMA PARAMETERS IN A SIMULATED THERMIONIC CONVERTER. Shimada, K. JPL Quart. Tech. Rev.: 1: No. 3, 97-109(Oct 1971).

Cesium-filled thermionic energy converters are being considered as candidate electrical energy sources in future spacecraft requiring tens to hundreds of kilowatts of electric power. The high operating temperatures necessary for a large specific power and high efficiency inevitably impose stringent constraints on the converter fabrication to achieve the desired reliability of the power system. The converter physics for reducing operating temperatures and cesium plasma losses are being studied to achieve high reliability without sacrificing the power performance of the converters. Various cesium parameters which affect the converter performance are: (1) electron temperatures, (2) plasma ion densities, and (3) electric potential profiles. These were investigated using a Langmuir probe in a simulated converter. The parameters were measured in different cesium discharge modes. (auth)

5176 SNAP 19 VIKING RTG PROGRAM DEVELOPMENT PROGRESS. Brittain, W. M.; Schumann, F. A.; Strazza, N. P. (Teledyne Isotopes, Timonium, Md.). Trans. Amer. Nucl. Soc.; 15: No. 2, 603-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5177 GROWTH POTENTIAL OF THE SNAP 19 HIGH-PERFORMANCE GENERATOR THROUGH TECHNOLOGY APPLICATIONS. LaPorte, A. H.; Osmeyer, W. E. (Teledyne Isotopes, Timonium, Md.). Trans. Amer. Nucl. Soc.; 15: No. 2, 604(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5178 ISOTOPE BRAYTON SPACE POWER SYSTEMS AND THEIR TECHNOLOGY. Schwartz, Herman (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 15: No. 2, 604-5 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5179 FIVE-KILOWATT RADIOISOTOPE THERMIONIC POWER SUPPLY (RTPS) FOR OUTER PLANETARY EXPLORATION. Bradshaw, G. B. (Gulf General Atomic Co., San Diego, Calif.); Homeyer, W. G.; MacKay, J. S. Trans. Amer. Nucl. Soc.; 15: No.2, 605-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5180 ADVANCED CASCADED SPACE NUCLEAR POWER GENERATORS. Bradshaw, G. B.; Perry, L. W. (Gulf General Atomic Co., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 606(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5181 STIRLING ENGINE PIEZOELECTRIC (STEPZ) POWER SOURCE CONCEPT FOR SPACE APPLICATIONS. Martini, W. R.; White, M. A.; Gasper, K. A. (McDonnell Douglas Corp., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 607(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5182 NEXT STEP IN NUCLEAR SPACE POWER SYSTEMS: THE MULTI-HUNDRED WATT RTG. Arker, A. J. (General Electric Co., Philadelphia). Trans. Amer. Nucl. Soc.; 15: No. 2, 607-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5183 RADIOISOTOPE/ELECTROTHERMAL THRUSTER FOR SPACECRAFT APPLICATIONS. Simms, R. (California State Univ., Northridge). Trans. Amer. Nucl. Soc.; 15: No. 2, 617-18(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5184 EFFECTIVE ENERGY UTILIZATION. Brown, H. L.; Hamel, B. B.; Nwude, J. K. (Drexel Univ., Philadelphia). Trans. Amer. Nucl. Soc.; 15: No. 2, 647-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Facilities and Equipment

Refer also to abstract 6922.

5185 (SC-TM-68-406) DESIGN AND PERFORMANCE CALCULATIONS OF MINIATURE DC MOTORS. II. THE PERMANENT MAGNET FIELD. Himebrook, F. S. (Sandia Labs., Albuquerque, N. Mex.). Aug 1968. 30p. Dep. NTIS.

A design approach for use with miniature dc motors is described which is concerned only with the permanent magnet. The armature design and performance calculations are considered in other memorandums in this series. (J.R.D.)

5186 TUNED FLOATING PLATFORM FOR OFFSHORE POWER FACILITIES. Holmes, John F.; Fink, Charles R. (Sanders Nuclear Corp., Nashua, N. H.). Mech. Eng.; 94: No. 10, 37-42(Oct 1972).

The design of floating platforms for offshore nuclear power plants is discussed in terms of design considerations for "tuned" (i.e., gyroscopically balanced or having a natural roll frequency much lower than the exciting frequency of all conceivable waves) spherical platforms which could contain the weight of the reactor system and would permit satisfactory operation of the nuclear power plant components including the reactor, turbine, and generator. Problems which must be considered are: methods for constructing, towing, emplacement, and mooring of the platform; collision avoidance; and the control of damage from collisions. (L.C.L.)

5187 NUCLEAR TRAINING FOR LATIN AMERICA: AT HOME OR ABROAD? McGuire, S. A.; Martin, J. G. (Secao de Energia Nuclear, Rio de Janeiro). Trans. Amer. Nucl. Soc.; 15: No. 2, 638(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Heat Transfer and Fluid Flow

Refer also to abstracts 5016, 5017, 5617, 5676, 6918, 6923, 6924, 6931, 6997, 7007, 7012, and 7235.

5188 CONVECTIVE HEAT TRANSFER IN AXIAL FLOW THROUGH BANKS OF RODS OR TUBES. Markoczy, Gy. Munich; Technische Univ. (1971). 155p. (In German). Thesis.

The convective heat transfer in tube bundles and rod bundles with forced, turbulent axial flow was investigated theoretically and experimentally. It is shown that the heat transfer coefficients in such complex configurations cannot be obtained by simple geometry-dependent correction terms superimposed on a known correlation for circular tubes. Following a search for new effective parameters, relations are developed which allow the determination of local heat transfer coefficients in bundles of various configurations with a sufficient accuracy. Two computational procedures are proposed; a comprehensive analytical one and a simple semiempirical one. The applicability of both procedures has been tested and confirmed by approximately 2000 measurements which are reported in detail, as well as by 940 measured data which were taken from the literature. (GF)

5189 LIQUID-VAPOR FLOW. Semeria, R. (CEN, Grenoble, France). 43p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972). (In French).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

Some definitions concerning the formation of a two-phase liquid-vapor flow in a subcritical vapor generator are given. The different flow configurations in vertical and horizontal tubes are enumerated. The formation of bubbles on a heating wall and the permanent drying of this heating wall in the case of a vertical tube (water at low and high pressures), a horizontal tube, a helical tube, and an elbowed tube were studied. The effect of deposits on the heating surfaces is considered. Transient regions and instabilities are mentioned. (France)

5190 CHANNELING CORRECTIONS FOR VOID FRACTION MEASUREMENTS. Neti, S. (Univ. of Kentucky, Lexington); Hahn, O. J.; Nondic, N. N. Trans. Amer. Nucl. Soc.; 15: No. 2, 879-80(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5191 DIABATIC LOCAL VOID FRACTION MEASUREMENTS IN FREON-114 WITH A HOT-WIRE ANEMOMETER. Shiralkar, B. S.; Lahey, R. T. Jr. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 880(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5192 DRY VERSUS WET HEAT TRANSFER PROCESSES. Berliner, P. (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 2, 881-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Materials Testing

Refer also to abstracts 5601, 5611, 5649, and 5676.

5193 (ORNL-TM-3415) DIAGNOSTIC PROCEDURE FOR THE EVALUATION OF STRAIN DATA FROM A LINEAR ELASTIC TEST. Dodge, W. G.; Smith, J. E. (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 58p. Dep. NTIS.

Many engineering structures respond linearly to applied loads within restricted ranges of these loads. Strain-load measurements conducted at selected points in such structures are called linear elastic tests. Nonlinearities in the data obtained from these tests are expected to arise from errors in measuring or recording either the strains or the loads. A diagnostic procedure to identify and distinguish between the two types of errors is described. The procedure depends only upon the hypothesis that the strains obtained from a linear elastic test are proportional to the loads; thus it is generally applicable to all tests of this type. The general-purpose data-reduction program LINDA is included, which implements the diagnostic procedure, and the subroutine NØSEY. Applicable tables of computer output from elastic response tests of one ANSI standard piping tee are also included. (auth)

5194 INSTRUMENTATION TECHNIQUES FOR STRAIN MEASUREMENTS IN CONCRETE PRESSURE VESSELS AND SIMILAR STRUCTURES. Hornby, I. W. (Central Electricity Research Labs., Leatherhead, Eng.). Strain; 8: No. 3, 110-11 (Jul 1972).

A description is given of instruments and techniques that have been employed by the Central Electricity Generating Board for short and long term strain measurements in prestressed concrete pressure vessels, and the methods adopted for data logging and subsequent data reduction. The measurements and tests on samples required to interpret the site readings are also described. (auth)

5195 NONDESTRUCTIVE TESTING INSTRUMENTS FOR COATINGS (BASED ON MATERIALS OF THE INTERNATIONAL EXPOSITION CONSTRUCTION MATERIALS 71). Meas. Tech. (USSR) (Engl. Transl.); 15: No. 5, 792-7(May 1972).

Translated from Izmer. Tekh.; 15: No. 5, 81-4(May 1972).

Instruments for nondestructive inspection of galvanic and other types of plating are described. Descriptions are included for instruments based on beta backscattering, electric microresistance, eddy currents, and magnetic field strengths. (J.R.D.)

5196 DENSITOMETER-BEAM EFFECTS IN HIGH-RESOLUTION NEUTRON RADIOGRAPHY. Harms, A. A.; Blake, T. G. (McMaster Univ., Hamilton, Ont.). Trans. Amer. Nucl. Soc.; 15: No. 2, 710(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5197 USE OF INELASTIC MATERIAL PROPERTIES IN HIGH-TEMPERATURE STRUCTURAL ANALYSIS. Bermin, I.; Pai, D. H. (Foster Wheeler Corp., Livingston, N. J.). Trans. Amer. Nucl. Soc.; 15: No. 2, 739(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5198 MINIATURIZED UNIAXIAL CREEP MACHINE FOR REMOTE APPLICATIONS. Barker, R. W.; Lovell, A. J. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 762-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Nuclear Explosions

5199 (SC-CR-723177) CRATER SCALING AS A FUNCTION OF CHARGE BURST DEPTH. Carlson, R. H. (Boeing Co., Seattle, Wash. Sandia Labs., Albuquerque, N. Mex.). Feb 1970. 74p. Dep. NTIS.

Apparent crater dimensional scaling parameters as functions of scaled charge burst depth for explosive events in playa, desert alluvium and basalt are determined empirically. An iterative technique is used to determine a dimensional scaling exponent which is the same as the exponent used to scale charge burst depth. This results in fit tolerances and correlation coefficients which appear to be equivalent or better than those exhibited when the charge burst scaling exponent is determined arbitrarily. (auth)

5200 SEISMIC INTERACTION OF SOIL AND POWER PLANTS. Isenberg, J.; Adham, S. A. J. Power Div., Amer. Soc. Civil Eng.; 98: No. PO2, 273-91(Oct 1972).

Bedrock motions are generated from a segment of the Golden Gate record and are applied to a four-layer elastic finite element of a soil site. Three different finite element models are derived to represent a nuclear reactor structure, each reflecting a different degree of refinement. The least refined is a one-dimensional model, having lumped masses, which is rigidly connected to the soil and is subjected to motions found at 45-ft depth in the free field. A second model is identical to the first except that springs are interposed between the base of the one-dimensional model and the soil in order to represent translational and rotational

modes of interaction. The most refined of the present models is a two-dimensional, dynamic, elastic finite element representation of the soil embedded foundation and walls and containment and support structures. The results of the various analyses are compared and conclusions are drawn regarding the necessity to include a refined model of soil/structure interaction in seismic analyses. (auth)

5201 DISTRIBUTION, FOCAL MECHANISMS, AND FREQUENCY OF EARTHQUAKES IN THE FAIRVIEW PEAK AREA, NEVADA, NEAR THE TIME OF THE BENHAM EXPLOSION. Smith, B. E.; Coakley, J. M.; Hamilton, R. M. (National Center for Earthquake Research, Menlo Park, Calif.). Bull. Seismol. Soc. Amer.; 62: No. 5, 1223-40(Oct 1972).

Six portable seismographs were operated for 30 days in a network centered 25 km south of the epicenter of the 1954 Fairview Peak earthquake. The recording period lasted from 15 days before to 15 days after detonation of the one-megaton Benham underground nuclear explosion 250 km to the southeast of the Nevada Test Site on December 19, 1968. Approximately 950 earthquakes were detected within about 30 km of the network. No evidence was found that the explosion affected the rate of earthquake occurrence. Locations were computed for 152 earthquakes. The epicentral pattern shows north and northeast trends about 1 to 3 km wide. Focal depths range from 5 to 14 km. The main zones of activity seem to have a near-vertical orientation. Composite fault-plane solutions suggest that faulting within zones is not consistent with a single focal mechanism. Instead, a variety of mechanisms is indicated, consisting primarily of north-striking right-lateral oblique-slip, and northeast-striking dip-slip movements. In both cases, the pressure axis is near vertical and the tension axis is near horizontal, striking about S60°E. (auth)

5202 HOMOMORPHIC DECONVOLUTION OF SOME TELESEISMIC EVENTS. Ulrych, T. J.; Jensen, O. G.; Ellis, R. M.; Somerville, P. G. (Univ. of British Columbia, Vancouver). Bull. Seismol. Soc. Amer.; 62: No. 5, 1269-81(Oct 1972).

Homomorphic filtering has been used to deconvolve three earthquake and one underground nuclear explosion seismograms recorded at Leduc, Alberta. Comparison of actual recordings with seismograms synthesized using deconvolved wavelets together with a crustal response computed from a well-defined crustal model shows striking correlations. This improved wavelet extraction procedure is expected to be an aid in Q, source mechanism, and depth studies as well as crustal deconvolution investigations. (auth)

5203 EARTHQUAKES CAUSED BY UNDERGROUND NUCLEAR EXPLOSIONS ON PAHUTE MESA, NEVADA TEST SITE. Hamilton, R. M.; Smith, B. E.; Fischer, F. G.; Papanek, P. J. (National Center for Earthquake Research, Menlo Park, Calif.). Bull. Seismol. Soc. Amer.; 62: No. 5, 1319-41(Oct 1972).

The underground nuclear explosions Benham, Purse, Jorum, and Handley, detonated on Pahute Mesa, initiated earthquake sequences lasting approximately 70, 10, 20, and 60 days, respectively. Earthquakes of magnitude 2.0 or larger in these sequences numbered 2012, 24, 159, and 231, respectively; earthquake magnitudes were all less than 5. The explosion Pipkin, also detonated on Pahute Mesa, had no apparent effect on seismicity. Ninety-four percent of the earthquakes with well-determined focal depths occurred at depths shallower than 5 km, and 95% of the located earthquakes were within 14 km of ground zero of the preceding explosion. There is no evidence for explosion-stimulated earthquake activity extending outside the area of Pahute Mesa. The spatial distribution of earthquakes seems to be largely controlled by geological structure; however, the epicenter distribution can be correlated with observed fault movement only for aftershocks of Handley. Fault-plane solutions indicate predominant dip-slip movement in the northern part of the Pahute Mesa area for aftershocks of Benham, Jorum, and Handley. In the southern part, dextral strike-slip movement was found for aftershocks of Benham and Handley. The frequency-magnitude relations are similar for earthquakes following Benham, Purse, Jorum, and Handley. (auth)

5204 WINB-NSF PLOWSHARE TECHNOLOGY ASSESSMENT PROJECT. Whatley, A. T.; Rogers, W. M. Jr. (Western Interstate Nuclear Board, Lakewood, Colo.). Trans. Amer. Nucl. Soc.; 15: No. 2, 620(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5205 POSTULATED ENERGY TRENDS. Bellamy, J. C. (Univ. of Wyoming, Laramie). Trans. Amer. Nucl. Soc.; 15: No. 2, 620-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5206 ENERGY AND MATERIAL RESOURCES ANALYSIS. Bell, P. A.; Whan, G. A. (Univ. of New Mexico, Albuquerque). Trans. Amer. Nucl. Soc.; 15: No. 2, 621(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5207 SOME LEGAL PROBLEMS CONFRONTING PLOWSHARE. Engdahl, D. E. (Univ. of Colorado, Boulder). Trans. Amer. Nucl. Soc.; 15: No. 2, 621-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5208 ENVIRONMENTAL IMPACT IN INDUSTRIAL PLOWSHARE APPLICATIONS. Busch, R. D.; Bell, P. A.; Whan, G. A. (Univ. of New Mexico, Albuquerque). Trans. Amer. Nucl. Soc.; 15: No. 2, 622(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5209 PROSPECTIVE NUCLEAR-STIMULATED GEOTHERMAL RESOURCES IN UTAH. Sandquist, G. M. (Univ. of Utah, Salt Lake City); Rogers, V. C.; Betts, J. F. Trans. Amer. Nucl. Soc.; 15: No. 2, 622-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5210 RECENT DEVELOPMENTS IN EXPLOSIVE EXCAVATION TECHNOLOGY. Lattery, J. E. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 15: No. 2, 624(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5211 WATERWAY EXCAVATION IN VENEZUELA. Paz-Castillo, F.; Kruger, P. (Stanford Univ., Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 624-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5212 EJECTA FROM A ROW-CHARGE CRATERING EXPLOSION. Vortman, L. J. (Sandia Labs., Albuquerque, N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 625(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5213 IMPROVEMENTS IN OR RELATING TO NUCLEAR EXPLOSION DETECTION SYSTEMS. Fothergill, R. A.; Bennett, R. F. C.; Risley, G. T.; Weeks, W. S. (to United Kingdom Atomic Energy Authority). British Patent 1,279,400. 28 Jun 1972. Filed 10 Dec 1968.

Reference is made to nuclear explosion detection systems for explosions taking place at or above ground level. BP 1,165,331 describes such a system. The present specification describes an improved system that enables detection to be extended to lower yields, which may be <1 kiloton under suitable conditions, and also the chance of false alarms (such as due to lightning) to be reduced. (UK)

Protective Structures and Equipment

5214 IMPROVEMENTS IN OR RELATING TO FILTERS. Taylor, Roland (to United Kingdom Atomic Energy Authority). British Patent 1,285,574. 16 Aug 1972. Filed 17 Apr 1969.

Reference is made to filters for liquid aerosols. The filter assembly described comprises a substantially solid cylindrical filter element, situated within a tubular housing and contacting the walls of the housing. The filter element consists of layers of wire mesh rolled together upon themselves to form a cylindrical spiral; some of the layers are composed of wire of greater diameter than the rest. It is considered that the liquid aerosol droplets collect on the wire by diffusion, impaction and interception, that the gas flow through the filter forces the droplets along the wire until they coalesce, and that the open structure allows drainage of coalesced droplets, providing wetting of the wire does not occur. The nature of the surface of the wire depends on the liquid being filtered. The coarser wire layers serve to facilitate drainage without providing free paths for aerosol avoiding filtration. The system finds one application in the filtering of the blanket gas used in Na cooled nuclear reactors above the reactor core. This gas comes into contact with hot Na and on cooling is liable to form a fine aerosol. Stainless steel wire may be used for a liquid Na aerosol. (UK)

5215 PROTIVORADIATSIONNYE UKRYTIYA V SEL'SKOI MESTNOSTI. (Fallout Shelters in Rural Areas). Volynaev, Yu. P. (ed.). Moscow, Voennoe Izdatel'stvo Ministerstva Oborony SSSR (1972). 40p.

This booklet was designed to interest the average citizen in civilian defense against radiation hazards, inform him regarding the nature of radiation, and to suggest practical measures for

personal defense and protection against fallout. Several line drawings illustrate above-ground and subterranean shelters for a single family or small groups and special protection for water wells. (K.S.W.)

5216 COLLECTING SYSTEM FOR PARTICULATE MATTER. Kaguchi, A. (Nitta Belting Co., Tokyo). Kuki Seijo; 8: No. 7, 29-31(Mar 1971). (In Japanese).

According to standards of American Association for Contamination Control, the high efficiency particle air filters are defined as follows: collection efficiency is not less than 99.97% for particles of 0.3 μ and initial pressure loss does not exceed 1 in water gage under rated air mass flow. In order to measure these performances, DOP test method developed by U.S. Army Chemical Corp is employed. The USAEC demands the DOP test method be employed as a standard test method which ascertains that each high efficiency particle air filter unit used in facilities handling radioactive substances and for clean rooms satisfies the above requirements. The DOP testing machine, principles of generating aerosols, measurement of particle size and its adjustment, and measurement of collection efficiency of filters are described. (Japan)

5217 EXPERIMENTAL STUDY OF BASEMENT CEILING ATTENUATION FACTORS. Reynolds, R. S. (Mississippi State Univ., State College). Trans. Amer. Nucl. Soc.; 15: No. 2, 979-80(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Safety Engineering

5218 PRESSURE RELEASE SYSTEM. Schnitker, W. (to Internationale Atomreaktorbau GmbH). German Patent 2,049,792. 13 Apr 1972. (In German).

A description is given of a pressure-suppression system for equipment and containers in which at least one liquid and one gaseous medium is contained or can develop. The system is composed of a safety device which, upon exceeding a minimum pressure of response, quickly and completely opens a pipe and a cyclone separator. At the end of a nearly straight pipe and near the cyclone separator a substantial widening of the sectional area and/or deflection of the flow direction is provided. This feature is suitable for the dispersion of liquid plugs to reduce the load on the cyclone. (GF)

5219 GREENSBURG GLOVE-BOX FIRE TESTS. Bullock, T. P. (Westinghouse Electric Corp., Pittsburgh); Conway, J. W.; Fisher, F. D. Trans. Amer. Nucl. Soc.; 15: No. 2, 762(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

5220 NUCLEAR FUELS: THE BMBW SAYS: 25 MILLION DM WILL BE PROVIDED FOR THE PROMOTION OF URANIUM PROSPECTING IN 1972. Nucleus (Bonn); 18: No. 3-4, 19-21 (1972). (In German).

An outline is given of the present state of the prospecting projects to be carried out in Europe, Africa, North America and Australia, supported by the Federal Government. (GF)

5221 ULTIMATE MINERAL RESOURCE SITUATION: AN OPTIMISTIC VIEW. Goeller, H. E. (Oak Ridge National Lab., Tenn.). Proc. Nat. Acad. Sci. U. S. A.; 69: No. 10, 2991-2(Oct 1972).

An optimistic view of the US supply of mineral resources is presented. The problems associated with particular elements having limited resources are illustrated by considering the supply, demand, and recycling possibilities for five elements-copper, helium, phosphorus, titanium, and uranium. It is concluded that, in the future, greater use will be made of functional substitutes for these resources, that future designs will concentrate on minimizing waste of minerals by designing longer-life, miniaturized, and recyclable metal products, and that US mineral resources will be sufficient to meet future needs. (L.C.L.)

5222 METAL RESOURCES OF THE WORLD. PART 1. URANIUM. Davis, M. Environ. This Mon.; 1: No. 1, 77-84 (Jul 1972).

World energy requirements are estimated. A study is made of the supply position of uranium, which is the key material in the production of electricity by controlled nuclear fission. Uranium requirements are reviewed, and the known reserves and future prospects for new discoveries are discussed. In addition the methods of detection and mining of uranium ore are outlined. (auth)

5223 SISTEMY RAZRABOTKI MESTOROZHDENII URANOVYKH RUD. (Systems for Working Deposits of Uranium Ores). Chesnokov, N. I.; Petrosov, A. A. Moscow; Atomizdat (1972). 344p.

The principles and problems involved in working veins of uranium ores are discussed. Recovery of high-grade ore at considerable depths and at high temperatures, special treatment of complex crossing of veins, alternative methods of working ore veins, the technology of cleaning and extraction of the ore, and problems with the exhaustion of a deposit are analyzed. The radiation hazards inherent in uranium mining are considered. (K.S.W.)

Radioactive Effluents

Refer also to abstracts 5483, 7042, 7043, and 7107.

5224 RADIATION DECONTAMINATION. Sasaki, T. (Tokyo Metropolitan Univ.). pp 189-224 of Studies on Radiation Effects. /Hiyama, Yoshio (ed.). Tokyo; Tokyo Daigaku Shuppankai (1971). (In Japanese).

For protection of our environment from radioactive contamination, the following points of discussion are presented in the paper. (1) Preventive action should be taken, eliminating primal causes such as testing of nuclear weapons. (2) Early detection of radioactivity should be made. (3) Disposal action should be taken in the early stage of contamination. (4) Unnecessary wide spread of contamination should be avoided. (5) It should be recommended for certain short lived radionuclides to leave them in natural decay in the confined area of contamination. (6) Radioactive filters (shields) and preventive facilities and medicines should be improved and their early application should be taken as needed. In practice, disposal processing of radionuclides involves each case of contamination mechanism and migration process of different radionuclides. Further studies should be carried out to clarify the above matters and at the same time the radioactive waste disposal method should be more improved in practice. The ion exchange method is described in which foam separation method in particular was discussed as one of the effective methods of removal of radioactivity from water. Either ion exchange resin method or electric dialysis method by ion exchange membrane are applied at present for removal of radioactivity from milk. Both methods were described in detail. The increase in requirements for nuclear industries introduced relatively long-lived nuclides into the environment and subsequently caused significant problems of waste disposal processing. Practical application of various methods such as ion exchange and scavenging method are still in the developing stage. (Japan)

Radioactivity Monitoring and Transport

Refer also to abstracts 5214, 5480, 5497, 5569, 5571, 5763, and 7237.

5225 (EUR-4800(Vols.1 and 2), pp 105-38) ORGANIZATIONAL AND ECONOMIC ASPECTS OF ENVIRONMENTAL INVESTIGATIONS AND MONITORING IN THE VICINITY OF NUCLEAR FACILITIES. Bramati, L. (ENEL, Rome); De Cecco, G.; Ilari, O. May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The basic criteria adopted in Italy for the definition and monitoring of the discharge limits for radioactive effluents from nuclear power stations are outlined with particular reference to radioecological investigations. Practical considerations arising out of the application of these principles and criteria to the case of a nuclear power station situated in a typical European environment are discussed. In particular, the logical and chronological development of the various components of the environmental investigation necessary to establish the receptivity of the state for radioactive discharges in correlation with the construction times for the plant is illustrated. An attempt is also made to assess the economic investment required by the prior environmental investigations and routine environmental monitoring, in relation to the various aspects of the problem of radioactive pollution of the environment. The extent of the organizational and economic investment is assessed in relation to the magnitude of the radiological risks to be anticipated both for the critical population groups and for the population at large. (auth)

5226 (EUR-4800(Vols.1 and 2), pp 175-90) PATHWAYS FOR THE TRANSFER OF RADIONUCLIDES FROM NUCLEAR POWER REACTORS THROUGH THE ENVIRONMENT TO MAN. Blanchard, R. L.; Kahn, B. (Environmental Protection Agency, Cincinnati, Ohio). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Detailed studies were conducted on site and in the vicinity of a boiling water reactor (BWR) and a pressurized water reactor (PWR) nuclear power station. Concentrations of specific radionuclides were determined in the gaseous and aqueous effluents and in the environment for pathways such as atmospheric discharge → deposition on grass → cattle → milk → man; atmospheric discharge → deposition on leafy vegetables → man; atmospheric discharge → deposition on grass → cattle → beef → man; atmospheric discharge → inhalation exposure; atmospheric discharge → whole body external exposure; aqueous discharge → river → fish → man; and aqueous discharge → river → water supply → man. The radionuclide concentrations resulting from station effluents were below minimum detectable levels in most pathways. For these pathways, concentrations were estimated by applying published transfer and dispersion coefficients to measured effluent concentrations. The critical pathway at the BWR was determined to be external radiation to the whole body from gaseous fission products in the plume. The second most significant pathway was that leading to the consumption of milk. At the PWR, consumption of fish was determined to be the critical vector. The highest population exposure was several mr per year at the BWR, and considerably less at the PWR. (auth)

5227 (EUR-4800(Vols.1 and 2), pp 191-202) INDICATOR BASED SURVEILLANCE PROGRAM (MARINE) AT A NUCLEAR SITE. Bhat, I. S.; Kamath, P. R. (Bhabha Atomic Research Centre, Bombay). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Routine surveillance with some intensity is essential in populated areas as a fulfilment of public health responsibility. The difficulties of organizational and analytical effort are considerable, particularly in the aquatic environment where waters may transport activities significantly beyond the site limits. Stack releases in normal operations are very small but detection of trends of accumulation is important. In the environment of Tarapur Atomic Power Station, a systematic evaluation of trace elements contents in sea foods and vegetation has been utilized to study behavior of reactor releases under normal conditions.

Trace elements in spinach, onion leaves, radish leaves, and normally eaten vegetables have shown Fe (10,210 ppM) significantly higher in spinach ash than in others. Similarly jelly fish has shown higher Sr component in ash than in other pelagic fish tissue. Oyster flesh shows Cu (1500 ppM) Zn and Mn predominantly. The distribution of trace elements demonstrates their suitability as indicators of radioisotopic contaminants. Monitoring for fallout and reactor released activities confirm the suitability of the approach. The indicator based program achieves with economy what otherwise calls for elaborate organizational effort. (auth)

5228 (EUR–4800(Vols.1 and 2), pp 245-86) RADIOECOLOGICAL STUDY OF THE AREA AROUND THE EUREX PLANT IN SALUGGIA. Antonelli, A.; Bombace, M. A.; Cigna, A. A.; Cigna Rossi, L.; Laneri, U. (CNEN, Casaccia, Italy). May 1972. (In Italian).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The results of the radioecological survey carried out in the area surrounding the Eurex plant at Saluggia are presented in anticipation of the emission of low-level radioactive wastes following the commissioning of this plant. A precise examination was carried out of the hydrological situation of the site, in view of its particular features, since the surface and underground waters of the rivers concerned (Dora Baltea and Po) might be used as drinking water or for irrigation. For this reason, investigations were also carried out into the water supply of the area, the agriculture and the volume and destination of fishery produce. The investigation was complemented by experiments using tracers to determine the spread of radioactive effluents in the waters of the Dora Baltea and of the Po downstream of its confluence with the Dora itself. The data obtained permit an assessment of the receptivity of the environment and it will therefore be possible to use them to derive a discharge formula which will ensure a wide safety margin for both populations and the environment. (auth)

5229 (EUR–4800(Vols.1 and 2), pp 287-302) ENVIRONMENTAL CONTAMINATION BY TRITIUM. Koenig, L. A.; Winter, M. (Gesellschaft fuer Kernforschung, mbH, Karlsruhe, Ger.). May 1972. (In German).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

At the end of 1970 monitoring of environmental contamination by tritium in the area of the Karlsruhe Nuclear Research Center was substantially intensified. This followed increased discharges of tritium into the atmosphere and into the Rhine, amounting in 1970 to a total of approximately 2700 Ci. In the future even more tritium will be produced. The results of routine radioprotection monitoring show that the exposure of the population to tritium from fallout and from discharges from nuclear installations leads to whole-body doses of less than 0.2 mrem/y, so that there is at present no urgent necessity on radioprotection grounds for more intensive monitoring of tritium. However, low-level measurements performed at the maximum attainable sensitivity are likely to furnish worthwhile indications about the propagation of harmful agents in the atmosphere, ground water and surface waters. The measurement program undertaken, which is no longer confined as regards sampling to the area of the nuclear research center, has yielded initial results as to the tritium content of rainfall, surface water, ground water, and drinking water. In addition, propagation experiments with tritiated steam permitted the direct determination of meteorological propagation factors. The measurement technique and results obtained so far are described and interpreted. (auth)

5230 (EUR–4800(Vols.1 and 2), pp 459-75) PROBLEMS RAISED BY THE EVALUATION OF THE LIMITING RADIOLOGICAL CAPACITY OF A RECEIVING MEDIUM: GENERAL PRINCIPLES OF APPROACH. Lacourly, G. (CEA, Fontenay-aux-Roses, France). May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The limiting radiological capacity of a receiving medium for a given radionuclide present in a given physicochemical state can be defined as the quantity of this radionuclide which the medium can take at this point, per unit time and continuously, without being ultimately harmful to man and his environment. This definition implies an equilibrium situation able to persist indefinitely. On the basis of this definition, a general method of approach is proposed, based on establishing the critical population group and the critical pathways, in accordance with the recommendations of the International Commission on Radiological Protection. The limiting radiological capacity of a receiving medium depends on a great many parameters, associated either with man or his environment. Some of them, whose relative importance is discussed, have a determining effect on its evaluation. (auth)

5231 (EUR–4800(Vols.1 and 2), pp 561-84) IMPORTANCE OF DEPOSITION OF POLLUTANTS IN THE EVALUATION OF ENVIRONMENTAL POLLUTION. Tadmor, Jacob (Soreq Nuclear Research Centre, Yavne, Israel). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

In the theoretical evaluation of environmental atmospheric pollution due to release of pollutants from industrial plants, the deposition of the pollutant is seldom considered. Attention is directed to several aspects which emphasize the importance of taking into account the deposition of pollutants in the theoretical evaluation of pollutant concentration in the environment, as well as of measuring the actual deposition rate, especially for cases of continuous release. It is shown that when depletion of the pollutant in the environment, by deposition, is taken into account (e.g., velocity of deposition $v_g = 1$ cm/s) an increase in the height of release may cause an increase in the ground-level air concentration of the pollutant at a certain distance from the release point. This indicates that an increase in the height of stacks for release of pollutants is not always desirable. Deposition velocities of different pollutants have been measured for short-lived or instantaneous release; these values may not be valid for continuous release. During continuous release, the soil surface may become saturated by the pollutant and may not act as a perfect sink for additional deposition. The net flux of the pollutant to the soil and consequently the velocity of deposition would thus be expected to diminish with time until steady-state conditions are attained. The deposition velocity of a pollutant continuously released to the atmosphere is indicated to be lower than the velocities evaluated theoretically for instantaneous and continuous release and than that measured for instantaneous sources. (auth)

5232 (EUR–4800(Vols.1 and 2), pp 587-601) RADIOECOLOGY AS AN AID TO THE GENERAL ENVIRONMENTAL POLLUTION PROBLEM. Spaander, J.; Strackee, L. (National Inst. of Public Health, Bilthoven, The Netherlands). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

In recent years the behavior of radionuclides in ecological systems has been studied intensively in connection with the large scale release of these substances in the human environment. Considering radioactive waste as a special case of waste in general, the question can be raised as to how far the acquired knowledge in the field of radioecology can be applied to other environmental pollution problems. The basic principles underlying the controlled radioactive waste releases are reviewed in relation to public health hazards. Emphasis will be laid on the concepts of critical pathways and critical groups of the population. The important question of the combined effect of different pollutants is considered. The use of radioactive tracers in ecological studies is discussed. (auth)

5233 (EUR–4800(Vols.1 and 2), pp 603-22) APPLICATIONS OF RADIOECOLOGY PRINCIPLES TO DESIGN OF AIR POLLUTION EFFECTS RESEARCH PROGRAMS. Barth, D. S.; Engel, R. E. May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The fundamental problem in air pollution effects research is the development of a family of dose response relationships for different populations of receptors (man, animals, or plants). The most sensitive population must be identified since protection of the public health or welfare implies the protection of the most sensitive populations which are at risk. There is concern for both protection of man's health and the environment. All routes of entry of the pollutant of concern must be quantitated. Dose rate effects must be evaluated for both short and long term exposures. The question of whether or not there is a threshold for deleterious effects from a combination of routes is an important one. Thus the problem in developing an adequate effects research program for air pollutants is closely analogous to the comparable problem in radioecology. These analogies are developed in a general fashion and then applied to a special case such as cadmium or manganese. Effective management of total environmental resources requires a total systems approach taking all effects and interactions into consideration. Ultimately pollution must be controlled by comprehensive environmental standards if the total exposure to man and his environment is reduced to acceptable levels. (auth)

5234 (EUR–4800(Vols.1 and 2), pp 639-50) PERSPECTIVES OFFERED BY RADIOECOLOGY IN REGARD TO THE ENVIRONMENT. Bovard, P. (CEA, Fontenay-aux-Roses, France). May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The need to reconcile economic development and preservation of the environment is at present causing renewed interest in applied ecology. Concern about this has been present in the nuclear field for nearly 20 years and it is therefore tempting to wish to benefit from the experience acquired by radioecology. It seemed worthwhile and necessary for radioecology to make its contribution to the study and solution of the problems raised by the development of land and the prevention of harmful effects. On the national level, the technological progress and equipment from which the Radioecology Section of the Department of Protection of the Commissariat a l'Energie Atomique has benefited obliged them to assist with an enterprise which is much more urgent and more important than the mere control of radioactivity. This concern which has determined the direction of programs and work has now evolved toward the following actions: on the scientific level, the publication of original papers and on the practical level, the study of particular cases on the request of public or private "customers". Methods, material means, and human knowledge have been applied in turn to arrive at this result. (auth)

5235 (EUR–4800(Vols.1 and 2), pp 671-88) MINERAL COMPOSITION OF THE PARTICLE MATTER IN SUSPENSION IN THE AIR, IN URBAN AREAS AND IN A FOREST REGION EXPOSED TO INDUSTRIAL POLLUTION. Belot, Y.; Diop, B.; Marini, T.; Caput, C.; Quinault, J. M. (CEA, Fontenay-aux-Roses, France). May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Atmospheric particle matter has been collected on cellulose filters at several urban and forest stations. The use of analysis comprising a nondestructive neutron activation, high-resolution gamma spectrometry and computer processing of the spectra has made it possible to determine more than twenty trace elements in each sample. The results obtained have been subjected to a multidimensional statistical analysis to study the quantitative relations existing between certain mineral elements in relation to their sources and their transport in the atmosphere. (auth)

5236 (EUR–4800(Vols.1 and 2), pp 723-33) SURVEILLANCE OF ENVIRONMENTAL CONTAMINATION: CONCEPTS DEVELOPED FOR IONIZING RADIATIONS. Butler, G. C. (National Research Council of Canada, Ottawa, Ont.); Barry, P. J. May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Consideration of protection against ionizing radiations, as well as other environmental contaminants, consists of three elements: criteria, norms, and surveillance. Criteria are compilations of scientific information about the effects, both short- and long-term, of pollutants on receptors. This total has been embodied in the term "harm commitment". Since the knowledge about the risk of harm per unit dose is far from complete the "dose commitment" is used more frequently to indicate the magnitude of all the effects. The shape of the dose-effect curve has important consequences for assessing the effects of low doses and for adding and averaging the effects. Norms are maximum permissible levels of exposure for individuals and for populations. They are used, a) as the basis of designing installations and planning operations in industry, b) for calculating release limits of a pollutant, and c) as action levels for uncontrolled situations. In applying these to the exposures of populations, work with ionizing radiations has made two important contributions: the concept of critical path and critical group for estimating mean maximum exposures of individuals, and the consideration of risks of long-term damage to the population of a large region or of a whole country. Surveillance consists of identifying the contaminants and measuring the levels of contamination to which some individuals or populations of a species are exposed, as well as calculating the integrated exposures and estimating the consequences of these exposures or comparing the results of the calculations with the appropriate norms. Surveillance or monitoring should only be carried out for a specific purpose and the program should be the minimum required to achieve this purpose. Important contributions to the development of norms for exposure to ionizing radiations have been made by international bodies composed of individual scientists speaking for themselves. Perhaps for this reason there has been wide (almost complete) international acceptance of the protection norms recommended by these international bodies. (auth)

5237 (EUR–4800(Vols.1 and 2), pp 779-95) LESSONS FROM RADIOECOLOGY IN THE FIELD OF CHEMICAL CONTAMINATION OF THE ENVIRONMENT. Paoletti, Alfredo (Univ., Naples). May 1972. (In Italian).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The laws governing the atmospheric transport, fallout and washout of radioactive contaminants are also valid for other contaminants (Sahara dust, talc, DDT, lead, pesticides, etc.) captured hundreds of miles away from the point of emission or detected in layers of glacier snow. The presence of all these contaminants and of mercury in waters and on the sea bed in readily determined strata confirms that this aerial transport takes place, as well as the familiar path through water and industrial waste. Like radioisotopes, many chemical contaminants are concentrated in particular organisms of the biosphere and in particular in the hydrological filter-feeders, either by direct absorption or by transport in the food chain by algae, bacteria or corpuscular material, to which they become attached and whose progress they then follow. On the basis of an examination of the literature and of personal experiments, the advantages of using bioconcentrators and the concentration factor in the study of certain conventional contaminants are considered, and the possibility of using other radioecological concepts in this sector is investigated. (auth)

5238 (EUR–4800(Vols.1 and 2), pp 797-835) ROUND-TABLE DISCUSSION: RADIOECOLOGY AT THE SERVICE OF THE PROTECTION OF MAN AND OF THE ENVIRONMENT. Jammet, H.; Lafontaine, A.; Korringa, P.; Morley, F.; Ophel, I. L.; Feldt, W.; Recht, P. May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Discussions are included on acceptability of contamination risks, public health guide levels for radiation exposure, radioactive waste in the marine environment, control of environmental contamination, contamination in North America, radioecology, and environmental contamination. (J.R.D.)

5239 (EUR–4800(Vols.1 and 2), pp 909-22) CUMULATIVE EXPOSURE INDEX (CUEX) FOR ASSESSING ENVIRONMENTAL RELEASES OF RADIOACTIVITY. Kaye, S. V.; Booth, R. S.; Rohwer, P. S.; Struxness, E. G. (Oak Ridge National Lab., Tenn.). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The Cumulative Exposure Index (CUEX) is being developed to facilitate efficient realistic assessment of environmental releases of radioactivity. The aim of CUEX is to assess the release on the basis of time-integrated radionuclide concentrations measured in suitable environmental sampling media. Typical measurements would be concentrations of radioactivity in air or water or on the land surface. The measured concentrations are assessed against basic radiation safety standards recommended for members of the public by recognized authorities. Because the recommended standards are expressed in units of dose (rem), the CUEX index, of necessity, embodies environmental models and dose models to convert the measured environmental radionuclide concentrations into estimates of radiation dose to man. The final estimate of dose and dose commitment used in calculation of CUEX includes contributions for each radionuclide and exposure mode of significance, and is compared with the appropriate radiation dose limit to complete the assessment. As proposed, CUEX is a more appropriate index to apply to exposures of the public than are the MPC's. A schematic is presented for applying CUEX to nuclear plant siting using environmental systems analysis techniques to model the movement of radionuclides. (auth)

5240 (EUR–4800(Vols.1 and 2), pp 1039-56) ^{90}Sr CONTAMINATION OF GRASS, BASED ON SOME ECOLOGICAL PARAMETERS. Poelstra, P.; Frissel, M. J. (ITAL, Wageningen, Netherlands). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Radioecology aims to investigate the behavior of microquantities of radioactive material in the ecosystem, as fallout and activation products. These investigations should be carried out in a way that they may contribute to the prediction of the behavior of these products in the ecosystem. Such an investigation is described for the fallout product ^{90}Sr, resulting in the calculation of the ^{90}Sr contamination of grass based on some ecological parameters. The investigation is carried out on 12 permanent pastures, situated throughout the Euratom countries. Both soil and grass were annually sampled from 1958 till 1969, the soil in layers of 5 cm up to 25 cm. All samples are analyzed for ^{90}Sr and Ca. Based on a number of physicochemical considerations and using a computer, an equation was derived in order to calculate the ^{90}Sr contamination of the grass related to the accumulated ^{90}Sr in the soil, the ^{90}Sr deposition rate and a number of climatological-, physiological-, and soil parameters. (auth)

5241 (NERC-LV-539-13) OFF-SITE ENVIRONMENTAL SURVEILLANCE FOR THE XE PRIME NUCLEAR ROCKET ENGINE TEST SERIES. Final Report. (National Environmental Research Center, Las Vegas, Nev. (USA)). Nov 1972. Contract AT(26-1)-539. 44p. Dep. NTIS.

The National Environmental Research Center—Las Vegas performed radiological monitoring in off-site areas after the testing of the XE Prime nuclear rocket engine at the Nuclear Rocket Development Station during the period December 1968 to September 1969. Fresh fission products were detected in the off-site area after Experimental Plans (EP's) VC and IXA, conducted respectively on June 11, 1969, and August 28, 1969. Following EP-VC, the only indications of fresh fission products in the off-site area were one air sample collected at Diablo Maintenance Station (10°, 75 miles from the test stand) and two precipitation samples collected from puddles on the ground within six miles of Diablo. The postulated infant-thyroid dose equivalent estimated from the airborne radioiodine concentrations at Diablo was less than 1 mrem. Following EP-IXA, peak radiation exposure rates of approximately twice background were measured on GM survey instruments during cloud passage on Highway 25 in the Koyne's Mill area. No deposition was detected following cloud passage. Low levels of fresh fission products were detected in air samples collected northnortheast of the test stand as far as Ely, Nevada (25°, 174 miles). From all sampled locations, the highest potential exposure to airborne radioiodine occurred at Koyne's Mill (28°, 55 miles), where the maximum postulated infant-thyroid dose equivalent was 1.6 mrem. No radioiodine was detected in milk samples. (auth)

5242 DATA. SECTION IV. OTHER DATA. Radiat. Data Rep.; 13: No. 8, 452-66(Aug 1972).

Data from routine samplings of biological materials and other media are reported. Information is included on: methods and results of off-site surveillance around the NTS during July through Dec. 1968; the ^{131}I content of milk from NTS off-site environs; gross beta activity and radioisotope content of surface air near NTS; gamma exposure rates in NTS off-site environs, Dec. 1968 measurements of the ^{131}I, ^{133}I, ^{135}I, and ^{187}W content in milk and surface air at off-site locations; ^{187}W content in off-site water supplies; ^{90}Sr content in human bones sampled through the US during July to Oct. 1971; gamma radiation levels at BNL site during Jan. to July 1971; gross beta activity in liquid wastes at BNL site boundary during Jan. to July 1971; and the occurrence of an underground nuclear explosion at the NTS on July 20, 1972. (L.C.L.)

5243 DEPOSITION OF ^{85}Kr AND TRITIUM RELEASED FROM A NUCLEAR FUEL REPROCESSING PLANT. Tadmor, J. (Oak Ridge National Lab., TN). Health Phys.; 24: No. 1, 37-42(Jan 1973).

The atmospheric deposition parameters for ^{85}Kr and ^{3}H (as HTO vapor) continuously released from a nuclear fuel reprocessing plant are estimated. These include washout and dry deposition and deposition through adsorption on particulate matter. Theoretical considerations suggest that the deposition coefficients at steady state conditions, for a continuous radioactive source, are lower than those computed from the general deposition relations proposed to date, because of the interference of the corresponding stable elements in the atmosphere, and because of the imperfect sink characteristics of the soil surface. (auth)

5244 ENVIRONMENTAL RADIOACTIVE CONTAMINATION AND ITS CHEMICAL ANALYSIS. Miyake, Y. (Tokyo Univ. of Education). pp 27-109 of Studies on Radiation Effects. /Hiyama, Yoshio (ed.). Tokyo; Tokyo Daigaku Shuppankai (1971). (In Japanese).

Not only because of natural sources but because of testing of nuclear weapons, the environment has been gradually contaminated with radioactive substances which move, migrate, disperse, retain, or concentrate in the stratosphere, air, rain, snow, fallout, rivers and oceans, or earth's crust. The paper is a collective report that discusses chemical analysis of radionuclides in our natural environment. Radioactive values of ^{90}Sr, ^{137}Cs, ^{239}Pu, ^{238}Pu and ^{240}Pu contained in the fallout, rain, and snow have been measured throughout Japan and statistical analysis was made in relation to meteorological, geographical, and temporal characteristics of the radioactive fallout. It is considered that these radioactivities were mainly due to testings of nuclear weapons. Ninety percent of the radioactive fallout in Japan was found in the rain. Further studies were carried out on the retention time of radionuclides in the stratosphere, rate of radioactive migration in the air, disappearing rate of ^{90}Sr and ^{137}Cs in the earth's crust, and specific radioactive substances such as ^{14}C, ^{3}H, and ^{85}Kr in the environment. Content values of radioactive substances such as plutonium in the environment, human food, and tissues were measured by various radiation detectors. The radioactive value of ^{239}Pu was 0.04 to 0.2 mCi/km^2 per year which was obtained from the accumulated value, 0.92 mCi/km^2 in the fallout during the past 10 yrs from 1958 to 1968. The radioactive value of ^{238}Pu in the fallout obtained from the same survey was 34 μCi/km^2 per year. The radioactive value of ^{226}Ra in drinking water was 50 to 70 fCi/l in Tokyo, 48 fCi/l in Hiroshima. The ingestion value of ^{226}Ra was estimated 4 × 10^2 fCi/day/person. However, a more reliable standardized method of measurement should be established. (Japan)

5245 GAMMA CONTINUUM AT A FOSSIL-FUEL PLANT SITE. Gold, R. (Argonne National Lab., Ill.); Congel, F. J.; Roberts, J. H.; Strash, A. M. Trans. Amer. Nucl. Soc.; 15: No. 2, 639-40(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5246 RADIOLOGICAL SURVEILLANCE AT PRESSURIZED WATER REACTORS. Brinck, W.; Kolde, H.; Krieger, H.; Kahn, B. (Radiochemistry and Nuclear Engineering Research Lab., Cincinnati). Trans. Amer. Nucl. Soc.; 15: No. 2, 640-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5247 EVALUATION OF TWO INDIRECT EXPOSURE PATHWAYS FOR AIRBORNE ^{137}Cs, ^{54}Mn, AND ^{144}Ce–Pr. Voilleque, P. G.; Pelletier, C. A. (Atomic Energy Commission, Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 2, 648-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5248 ESTIMATES OF POTENTIAL NUCLEAR INDUSTRY CONTRIBUTIONS TO REGIONAL DOSE. Fletcher, J. F. (Westinghouse Hanford Co., Richland, Wash.); Dotson, W. L.; Bentley, B. W.; Soldat, J. K. Trans. Amer. Nucl. Soc.; 15: No. 2, 660-1 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5249 ANALYSIS OF RADIONUCLIDE RELEASES FROM DAMAGED NUCLEAR FUEL SHIPPING CASK. Fields, S. R. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 662(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Atmosphere

Refer also to abstracts 5398 and 5399.

5250 (EUR-4800(Vols.1 and 2), pp 397-404) CONSIDERATION OF STABLE ELEMENTS IN ENVIRONMENT IN THE EVALUATION OF THE MAXIMUM PERMISSIBLE CONCENTRATION FOR RADIONUCLIDES. Tadmor, Jacob (Soreq Nuclear Research Centre, Yavne, Israel). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The importance of the specific activity concept (the ratio between the concentration of a radioisotope and the total concentration of the same element in the environment) in the evaluation of the hazards resulting from a release of radioisotopes is discussed. An illustrative computation of maximum permissible concentrations (MPC) is made, taking into account the concentration of the corresponding stable element. (auth)

5251 (EUR-4800(Vols.1 and 2), pp 531-60) MODEL FOR PRELIMINARY CALCULATION OF THE ENVIRONMENTAL RECEPTIVITY FOR GASEOUS RADIOACTIVE EFFLUENTS FROM A BOILING WATER REACTOR NUCLEAR POWER STATION. Antonucci, Lino (Ente Nazionale per l'Energia Elettrica, Garigliano, Italy). May 1972. (In Italian).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Before any radioactive effluents are discharged, it is essential to carry out studies to prove that the dose of ionizing radiations to which the population will be exposed is acceptable and within legal limits. These investigations may be prolonged depending of course on the type and quantity of effluents, the characteristics of the site, and the degree of accuracy required in the estimation of the dose which is the ultimate purpose of the investigations. Before such an extensive program of studies is embarked upon, it is necessary to carry out a less complicated preliminary analysis using appropriate cautious criteria, to permit an initial estimate of the receptivity of the environment and to identify potential "critical parameters". On the basis of the anticipated discharges of effluent, it is thus possible to predict the order of magnitude of the dose to which the population will be exposed, given a general knowledge of the site characteristics. This type of analysis, which should not be regarded as purely theoretical, since it is possible to use the operating data for power stations using the same system, is necessary in order to: quickly predict the risk factor for a given site; design the radioactive effluent treatment system with the appropriate capacity; carry out a first evaluation of "critiques parameters;" program realistically the radioecological investiga-

tions; and specify an environmental monitoring network based as far as possible on the critical parameters. The application of these criteria to the case of gaseous effluents from boiling water reactor nuclear power station is outlined. (auth)

5252 (EUR–4800(Vols.1 and 2), pp 923-40) EVALUATION OF THE POTENTIAL RADIOLOGICAL IMPACT OF GASEOUS EFFLUENTS ON LOCAL ENVIRONMENTS. Cowser, K. E.; Reeves III, M.; Fowler, P. G.; Culkowski, W. M. (Oak Ridge National Lab., Tenn.). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Of particular current interest is the management and control of radioactive effluents from nuclear facilities. There is need to demonstrate how the many factors related to such releases enter decisions to locate nuclear power plants and allied facilities in the most effective locations. Such factors must be considered systematically to provide realistic estimates of potential dose equivalents to man. Descriptions are presented of the methods used and the models developed to permit estimates of dose equivalents to members of a potentially exposed population group from gaseous effluents. A computer code is used for the calculation of average annual downwind air concentrations and ground surface deposition rates for routine stack releases and displays results as contour plots. Parametric studies are possible since the code permits variation of meteorological variables and stack height, release rate, dry deposition velocity, washout coefficient, and a decaying chain of radionuclides emitted from the stack. Release of radioactive noble gas reported for a boiling water reactor is used to illustrate program application and the impact of parent-daughter decay chains and washout and fallout on dose estimation. (auth)

5253 DATA, SECTION III, AIR AND DEPOSITION. Radiat. Data Rep.; 13: No. 8, 442-51(Aug 1972).

Tabulated data are presented from April 1972 measurements of the gross beta activities in surface atmosphere and precipitation at 73 US and 24 Canadian sampling stations and in surface atmosphere only at 12 Pan American stations, 14 California stations, and 104 stations in 21 western US states. A short summary of the radioisotope content of air samples at 8 US locations is included. (L.C.L.)

Soil

Refer also to abstract 5570.

5254 (EUR–4800(Vols.1 and 2), pp 381-93) CYCLE OF SOME RADIOELEMENTS IN NATURAL SOILS. MAIN DATA FOR THE CONTROL OF A SITE. Saas, A.; Grauby, A.; Andres, J. (CEN, Cadarache, France). May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Results of studies of the decomposition of litter and the manner of introduction of radioelements into soil were used to show the role of these two factors in the development of contamination. Leaching by rain and foliar absorption by shrubby plants complete the cycle of development of radioelements and the data on the fixation and migration in the soil. Using these methods the cycle of manganese, cobalt, and cesium was studied. The integration of radioelements in the biological cycle depends on the manner of introduction. Leaching of radioelements by rain represents: 10% for cesium, 8% for manganese, and 4% for cobalt. These forms can be assimilated directly and are very mobile. The decomposition of plant debris progressively releases the mineral and organic elements in the course of the year. The migration in depth takes place according to the season and the elements released; this is also represented by a variation of the chemical forms present in the soil and the possibilities of absorption via the roots. These correlations including development of soils, age and distance of samples taken and access route are the basis for directives for rational control. (auth)

5255 (EUR–4800(Vols.1 and 2), pp 509-30) STRONTIUM CONCENTRATION FACTORS IN BIOTA AND BOTTOM SEDIMENTS OF A FRESHWATER LAKE. Ophel, I. L.; Fraser, C. C.; Judd, J. M. (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Evaluation of the capacity of aquatic ecosystems to accept waste radionuclides safely requires a knowledge of concentration factors in environmental materials and of the conditions which affect the magnitude of these factors. Stable element concentrations provide the best estimate of concentration factors which would be attained by the radioisotope under conditions of chronic contamination. Over a period of years the concentration factors of both stable and radioactive strontium in bottom sediments and biota were determined in a lake chronically contaminated with low levels of ^{90}Sr from radioactive wastes. Concentration factors (on a fresh weight basis) in six species of fish range from 450 to 1250; in 22 species of aquatic plants from 30 to 1300. Each species exhibits a characteristic concentration of the element. The strontium content of bottom sediments is strongly correlated with the amount of organic matter they contain. The specific activity of the strontium (dpm $^{90}Sr/\mu g$) appears to be uniform throughout the water and the lake biota, i.e., biological availability of the stable isotope and radioisotope is the same. In the upper 10 cm of bottom sediments, however, specific activity of the exchangeable strontium and of total strontium is only half that in biota and water indicating incomplete exchange of radionuclide and stable element in this layer even after fifteen years of exposure. (auth)

Water

Refer also to abstract 5576.

5256 (EUR–4800(Vols.1 and 2), pp 139-74) REVIEW OF THE DISPERSION OF RADIONUCLIDES IN RIVER BASIN. PERSPECTIVES IN RELATION TO THE NUCLEAR ACTIVITIES: PROCESSING PLANTS AND POWER REACTORS. Picat, P. (CEN, Cadarache, France); Bovard, P.; Grauby, A.; Ijuin, M.; Reveillault, J.; Faure, J.; Andres, J. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The presence of nuclear installations on the Rhone basin prompted a study on the effect of their waste on the parts of the Rhone River situated downstream of the 4 Centers of Grenoble, Pierrelatte, Marcoule, and Cadarache. Study of the Rhone River over a distance of 60 km shows that its radioactive pollution is due to the presence of ^{137}Cs (4.8 curies deposited on the bottom) and to that of ^{106}Ru and ^{90}Sr. The ^{137}Cs concentrations of the sediment of the Rhone in 1968 are comparable with those recorded in 1960 on the Tennessee River. The distribution of the radioactivity on the bottom is characterized by decreasing contents from upstream to downstream and from the banks towards the middle of the river, and the absence of a significant rise in specific activity at the mouth. (auth)

5257 (EUR–4800(Vols.1 and 2), pp 223-43) DETERMINATION OF THE MAXIMUM PERMISSIBLE CONCENTRATION OF ^{226}Ra IN WATER IN THE PRESENCE OF SULFATE. Boulenger, R.; Koch, G.; Weyers, C.; Gerard, A.; Baton, J.; Verhoeven, F. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

In waters contaminated by ^{226}Ra and where the calcium and sulfate content can lead to precipitation of $CaSO_4$, the question is to know if, from the point of view of radioprotection, the radium must be considered as soluble or as insoluble. Results of physicochemical experiments show that, in spite of a large excess of sulfate ions, a small part of the radium is absorbed by the precipitated calcium sulfate. Experiments have been done to compare the biological availability of radium fed to mice by gastric tubing, under different chemical forms. Experimental results indicate that, in this case, radium must be considered as soluble. (auth)

5258 (EUR–4800(Vols.1 and 2), pp 303-46) RADIOECOLOGICAL INVESTIGATIONS IN THE GULF OF TARANTO. I. GENERAL CIRCULATION IN THE GULF OF TARANTO AND DIFFUSION PROCESSES OFFCOAST THE TRISAIA CENTER. Cagnetti, P. (CNEN, Casaccia, Italy); Bernhard, M.; Zattera, A. May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The data of 3 hydrographic cruises into the Gulf of Taranto are considered together with one from Grancini et al. (1969). Preliminary diffusion experiments with Rhodamine B and direct current measurements near the two planned outfalls offcoast the CNEN nuclear center (Trisaia, Policoro) are described. From the data obtained several models for the distribution of hypothetical releases of radioisotopes are discussed. The Joseph–Sendner model was utilized for the prediction of small range diffusion. A compartmental model assuming a stationary eddy of 10 km diameter in the release area was used for the prediction of larger range diffusion. The mean concentration of the radioisotopes in the seawater calculated with hypothetical release from either model is of the same order of magnitude. (auth)

5259 (EUR–4800(Vols.1 and 2), pp 347-80) RADIOECOLOGICAL INVESTIGATIONS IN THE GULF OF TARANTO. II. PRELIMINARY ESTIMATION OF THE RECEPTIVITY FOR LOW LEVEL RADIOACTIVE WASTES OF THE SITE IN THE GULF OF TARANTO. Bernhard, M. (CNEN-EURATOM, La Spezia, Italy);

Cagnetti, P.; Nassogne, A.; Peroni, C.; Piro, A.; Zattera, A. May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Preliminary data on the geochemical and biological environment of the planned outfall area in front of the CNEN Trisaia center (fuel processing plant) are presented and the accumulation of different radionuclides by these components of the marine environment are estimated. The distribution of the fishery products from the release area and their consumption by the population in the area are discussed. Most of fishes caught are distributed through the large fish market of Taranto and only ½% is consumed locally. Utilizing two different models, one based on a stationary eddy and the other one on a diffusion model (Joseph–Sendner model for continuous release), described in the paper of Cagnetti et al., 1971, the "limiting capacity" of the outfall area has been calculated. The results show that the Joseph–Sendner model predicts the smallest capacity for the area. External exposure to "beach fishermen" and internal exposure to trawler crews are the limiting population factors. (auth)

5260 (EUR–4800(Vols.1 and 2), pp 425-41) BEHAVIOR IN A RIVER OF ^{60}Co AND ^{54}Mn FROM EFFLUENTS OF A PWR POWER STATION. Kirchmann, R. (CEN/SCK, Mol, Belgium); Cantillon, G. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Under a program of concerted discharges of effluent from the Ardennes nuclear power station (SENA), two experiments were conducted under natural conditions to evaluate the coefficient to distribution of ^{60}Co and ^{54}Mn between the water and the suspended matter, and to determine the biological availability of these activation products, an aquatic moss being used as an indicator. The experimental apparatus and the sampling techniques are described and the experimental results are compared with laboratory findings. In addition, because of the presence of tritium in the form of tritiated water in the effluents, it was possible to check the homogeneity of diffusion of the discharge in the Meuse from the first sampling point about 10 km downstream of the station. (auth)

5261 (EUR–4800(Vols.1 and 2), pp 477-507) RADIOECOLOGICAL ANALYSIS OF THE UPPER DANUBE. Ruf, M. (Demoll-Hofer-Institut, Munich). May 1972. (In German).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

To assess the radiation risk associated with the discharge of radioactive effluent from nuclear power plants, radioecological studies are being carried out in the upper Danube. The disposal of effluent from the 237-MWe demonstration nuclear power plant at Gundremmingen (KRB) is used as an example. With the aid of mixed samples from the primary cooling circuit, the reactor effluent, and the Danube, a balance has been drawn up to show the extent of radioactive waste disposal since the commissioning of the boiling water reactor. According to the results so far the radioactivity to be attributed to the effluent disposal in the Danube is mainly caused by ^{89}Sr, ^{90}Sr, ^{137}Cs, ^{134}Cs, ^{131}I, ^{140}Ba, ^{140}La, ^{58}Co, ^{60}Co, and particularly tritium. The ecological behavior of the radioactive waste products in the mainstream has been examined and a preliminary assessment made of the radiological capacity of the upper Danube. This took into account the provision of drinking water, consumption of fish, the irrigation of land used for agriculture, the external radiation dose for anglers, swimmers, and maintenance workers on the river bed. The basis of the calculation was the recommendation of the German Atomic Commission whereby the radiation dose for the population attributable to the disposal of liquid radioactive waste in the vicinity of nuclear installations is not to exceed a value of 30 mrem/year. (auth)

5262 (EUR–4800(Vols.1 and 2), pp 651-70) EXPERIENCE WITH RADIOACTIVE EFFLUENTS AS A MODEL FOR IMPROVED MONITORING OF INDUSTRIAL EFFLUENTS. Aurand, Karl (Institut fuer Wasser-, Boden-, und Lufthygiene des Bundesgesundheitsamtes, Berlin). May 1972. (In German).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

In recent years surveys and investigations of the discharge of radioactive effluents have been undertaken both at laboratories working with radioactive materials and at nuclear power stations. Allowing for the radioecological facts, the decisive criterion for the assessment of the discharge is not the concentration of the radionuclides when they enter the receiving water but the total quantity of the individual radionuclides released and their radiotoxicity. The development of continuous sampling techniques for effluents made it possible to obtain representative mixed samples, which can be examined discontinuously by gamma-spectroscopic and radiochemical methods for the individual nuclides. This technique thus permits more effective monitoring than is possible with continuous measurements of overall activity. It also enables "demonstration" samples to be taken and stored for inspection purposes. Practical results are reported. The results constitute practical material which can be applied in the optimization of monitoring of conventional effluents. (auth)

5263 (EUR–4800(Vols.1 and 2), pp 839-67) APPLICATION OF A MATHEMATICAL MODEL FOR DETERMINING AT COMMUNITY SCALE THE DISCHARGE STANDARDS FOR RADIOACTIVE EFFLUENT. Branca, G. (CNEN, Rome); Breuer, F.; Cigna, A. A.; Amavis, R. May 1972. (In Italian).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

In a previous publication by the same authors a mathematical model was developed for defining a formula for the discharge of liquid radioactive effluents into surface waters. The general procedure is applied to various possible concrete cases, including that of a water course used for drinking purposes, that of a water course used for irrigation, that of a lake used for fishing and for water supplies, and that of a river along the course of which there are several discharges of radioactive waste. The possibility of applying the method to the problems associated with radioactive contamination of the air is also considered. (auth)

5264 (EUR–4800(Vols.1 and 2), pp 957-76) MATHEMATICAL MODEL OF MARINE DIFFUSION OF CONTAMINANTS AND RELEVANT EXPERIMENTAL MEASURES. Argiero, L.; Serra-Gentili, A. M.; Zoli, G. (C.A.M.E.N., Pisa, Italy). May 1972. (In Italian).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

By assuming the stereosymmetry of the diffusion process to be ellipsoidal, the analytical expression was found for the time-dependent concentration of contaminants, their position in relation to the point of discharge, the dimensions of the source, and the rate of diffusion in different directions. A seawater sampling device was designed and built, and a series of experiments were carried out with a view to measuring the rate of diffusion and checking the accuracy of the theoretical model. (auth)

5265 (EUR–4800(Vols.1 and 2), pp 1153-65) TRANSFER OF FISSION PRODUCTS FROM ATMOSPHERIC FALLOUT INTO RIVER WATER. Jacobi, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin, Ger.). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

A correlation of analytical results on fission products from nuclear weapon tests in the period 1956 to 65 and fission product activity in river water was carried out for 17 rivers in the Federal Republic of Germany. The results indicate that in a first approximation a linear relation: $c_W(pCi/l) = k_N \cdot a_N(mCi/km^2M) + k_B \cdot a_B (mCi/km^2)$ between the specific total-β-activity c_W of fission products in river water, the mean fallout rate a_N of fission products and the mean accumulated fission product activity a_B in the ground of the river drainage area can be accepted. For the considered rivers the time-averaged mean values of the coefficient k_N vary in the range of 0.1 to 0.3 m/m (m = month); the mean values of the coefficient k_B vary in the range of 0.007 to 0.03 m^{-1}. From the results the relative fractions of fallout activity can be estimated which are transferred directly or buffered into the surface water. (auth)

5266 (EUR–4800(Vols.1 and 2), pp 1167-74) INTERACTION BETWEEN WATER, TRACE ELEMENTS, AND DIFFERENT COMPONENTS IN THE DANUBE RIVER. Draskovic, R.; Radosavljevic, R.; Tasovac, T.; Zaric, M. (Boris Kidric Inst. of Nuclear Science, Vinca, Yugoslavia). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The environment is a complex system of interacting physical, chemical and biological components. The fate of radioactive and nonradioactive pollutants introduced into rivers and their influence on existing equilibria depend on specific characteristics of the aquatic environment. Temporal variations in ambient trace element concentrations may affect the accuracy of the predictions but these variations are functions of the biological half time of the element in ecosystems. Results of an eleven-year research program are presented concerning the Yugoslav section of the Danube river which included study of the characteristics of the river and its environment; interaction between water and dispersed inorganic and organic matter, and dispersion ability of the river as well as behavior of different trace and radioactive elements in the river and its components including biological and other environmental materials. The analyses show regularities on the large scale. (auth)

5267 (EUR–4800(Vols.1 and 2), pp 1221-37) OBSERVATIONS ON THE MODE OF CONTAMINATION BY ^{137}Cs OF THE MARINE

SEDIMENT IN THE REGION OF LA HAGUE. Guegueniat, P.; Ancellin, J. (CEA, Cherbourg, France). May 1972. (In French)

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The study relates to the experimental contamination by cesium-137 of certain coastal marine sediment in the region of La Hague. It is found that part of the cesium fixed is easily desorbed by the cations of sea water or by acid solutions of a normality less than 0.5 N (fixation on sites of low affinity), whereas another part can only be desorbed by acid solutions of a normality above 2 N (fixation on site of high affinity). In the cases studied, the retention of cesium by sediment in sea water is essentially linked with the presence of sites of high affinity. However this retention is not explained by the exchange capacity as the latter is in inverse relation to the degrees of contamination observed. On the other hand, in the case of contamination of the same sediment in fresh water, retention takes place on sites of high and low affinity and a comparison of the results obtained shows that fixation is proportional to the exchange capacity. The organic matter of the sediments studied exhibits in a fresh water medium, probably through cation exchange, a high capacity for the fixation of cesium, which is not found in a sea water medium. (auth)

5268 (EUR-4800(Vols.1 and 2), pp 1239-54) ^{106}Ru IN SEA WATERS. PHYSICOCHEMICAL BEHAVIOR AND CONTAMINATION EFFECT. Guegueniat, P. (CEA, Cherbourg, France); Bovard, P. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Ruthenium-106 in industrial radioactive effluent discharged into the sea is in the form of nitric complexes. By means of a method of chromatography on resins, enabling the physicochemical behavior of trace elements in a marine environment to be followed, several forms of ruthenium have been demonstrated. In the case of nitric complexes introduced without a carrier into this medium, the following soluble forms are found to exist: anionic, cationic, neutral, and organic. Note is made, in particular, that the presence of polymerized forms which have a very high "sorption potential" and which, as a result, are called upon to play an important part in the contamination phenomena. For two of these forms, previously isolated and introduced into 10 liters of sea water, the percentage of fixing on the walls of the containers was 80 and 95%. Similar behavior is observed in the case of the nitric complexes contained in an industrial effluent discharged into the sea; it should be noted however that on contact between the effluent and the sea water certain inactive compounds of the effluent precipitate and entrain the ruthenium, with the creation of new insoluble forms bound to the carrier. (auth)

5269 (EUR-4800(Vols.1 and 2), pp 1305-20) DETERMINATION OF CONCENTRATION FACTORS IN ABIOTIC AND BIOLOGICAL COMPONENTS IN THE GARIGLIANO RIVER. Antonelli, A.; Castaldo, M.; Cigna Rossi, L.; Laneri, U.; Pagnotta, R. (CNEN-CSN, Casaccia, Italy). May 1972. (In Italian).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

After a radioecological survey on the Garigliano river a low-level contamination due to ^{58}Co and ^{60}Co in samples of bottom sediment, plants, and animals was detected. Such radionuclides are discharged by an ENEL Nuclear Power Plant placed at 12 km from the estuary. Concentrations of ^{58}Co and ^{60}Co measured in samples collected recently are reported. Concentration factors between bottom sediments, plants and animals were calculated referring to the monthly values of the radionuclides discharged and the average river flow-rate. (auth)

5270 CONTENT OF ^{90}Sr AND ^{137}Cs IN BALTIC SEA WATER IN 1970. Ivanova, L. M.; Gedeonov, L. I.; Markelov, V. N.; (and others). At. Energ. (USSR); 33: No. 4, 835-8(Oct 1972). (In Russian).

Radiochemical determinations of the ^{90}Sr and ^{137}Cs concentrations at various points in the Baltic Sea, the average values being, respectively, 2 and 1.9 dps/liter. As the Danish Sound was approached, the concentrations dropped to nearly 1 and 1.5. The Atlantic Ocean, by comparison, was far less contaminated (about 0.2); the difference was ascribed to the nearly closed-basin nature of the Baltic Sea. (K.S.W.)

5271 DATA. SECTION II. WATER. Radiat. Data Rep.; 13: No. 8, 435-41(Aug 1972).

Tabulated data are presented on the gross alpha and gross beta radioactivity in US surface waters during Dec. 1971 and the tritium content of drinking water and surface waters in the US during Jan. to April 1972. (L.C.L.)

5272 SOURCES OF WATER POLLUTION ESTABLISHED BY USING A NEUTRON ACTIVATABLE TRACER. Schmotzer, J. K.; Jester, W. A.; Parizek, R. R.; Uhler, K. A. (Pennsylvania State Univ., University Park). Trans. Amer. Nucl. Soc.; 15: No. 2, 6 641-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Ecosystems and Food Cycles

Refer also to abstracts 5559, 5566, 5567, 5572, and 5573.

5273 (EUR-4800(Vols.1 and 2)) PROCEEDINGS OF INTERNATIONAL SYMPOSIUM ON RADIOECOLOGY APPLIED TO THE PROTECTION OF MAN AND HIS ENVIRONMENT, ROME, 7-10 SEPTEMBER 1971. (European Communities, Luxembourg. Commission). May 1972. 1421p. (In several languages). (CONF-710973-(Vols.1 and 2)). EUR B.Fr. 1500,-.

Issued in two volumes, but cataloged as a unit.

Sixty-five papers were presented at the conference; a separate abstract was prepared for each paper. (R.C.K.)

For abstracts of individual papers see: 5225-5240, 5250-5252, 5254-5269, 5274-5287, 5292, 5293, 5297, 5483, 5559, 5565-5568, and 5571-5577.

5274 (EUR-4800(Vols.1 and 2), pp 203-22) TRANSFER OF ^{226}Ra FROM INDUSTRIAL EFFLUENTS DISCHARGED INTO WATERCOURSES IN THE HUMAN FOOD CHAIN. Kirchmann, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium); Lafontaine, A.; Cantillon, G.; Boulenger, R. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

A description is given of the main features of a research program covering two sites where progressive contamination due to the presence of ^{226}Ra in industrial effluents discharged into watercourses in the Nethe basin had set in during the course of time. The program, carried out from 1961 to 1968, fell into three main parts: study of the movement and behavior of ^{226}Ra in the river bed, dispersal of the radioelement in the environment, and the pathways to man. The evaluation of the annual ingestion of ^{226}Ra due to contamination of the food chain is described, based on the concentrations of ^{226}Ra in agricultural produce taken from points selected according to the radiological map of the site, and on the results of farming on trial fields and grassland on contaminated land in an area zoned for the establishment of farms. A food survey showed which foods were to be taken into account as sources of ^{226}Ra contamination. The conclusions of the study, from the scientific and health viewpoints, are given. (auth)

5275 (EUR-4800(Vols.1 and 2), pp 405-23) BIOINDICATORS FOR MONITORING ^{137}Cs CONTAMINATION OF CERTAIN ECOSYSTEMS. Kreuzer, W. (Univ., Munich). May 1972. (In German).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The physiological and ecological behavior of Clad. rang. showed it to be a particularly suitable bioindicator for the monitoring of ^{137}Cs contamination of ecosystems such as those in grasslands, and land in the vicinity of nuclear installations. Previous research confirmed this supposition when certain caudelae were included in the sampling of lichens. The effect of the minimum surface size for samples, number of samples, and sampling personnel is not so important in the very uniform ^{137}Cs lichen contamination found in isohyetal areas, a fairly uniform topographical vegetation pattern as a freely exposed position and the sample of entire lichens. Studies show that for representative sampling in central European conditions the number of lichen samples (single specimens or batches of microspecimens) should not be less than 10 (homogeneous growth), 20 (inhomogeneous growth) and weigh at least 2.5 g, and the sampling surface should not be less than 21 m^2 for batch samples. (auth)

5276 (EUR-4800(Vols.1 and 2), pp 445-57) RADIATION PROTECTION ASPECTS IN AQUATIC RADIOECOLOGY. Feldt, W. (Bundesforschungsanstalt fuer Fischerei, Hamburg, Ger.). May 1972. (In German).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

On the basis of a definition of the radiological limit capacity, the relative importance of the separate links in the food chain from the radioprotection viewpoint is assessed. Taking the River Elbe as an example, a mathematical model is developed which relates radioactive discharges to the exposure of the population to radiation. Requirements as to siting and processing techniques for nuclear installations are derived from the basic radioecological model, which also covers the coastal regions. (auth)

5277 (EUR-4800(Vols.1 and 2), pp 623-37) APPLICABILITY OF RADIOECOLOGICAL CRITERIA AND METHODS TO THE CONTROL OF CONVENTIONAL POLLUTION. Antonelli, A. (CNEN, Rome). May 1972. (In Italian).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The principles of the protection of the population from radioactive pollution of the environment are critically examined, and the scope of the problem, which goes beyond the bounds of the specific problem of radioprotection, is stressed. The basic criteria, the "risk philosophy", the protection rules, and the methods adopted and now tested in the field of radioecology result from a realistic approach to the problem of the use of a new source of energy and its place in a modern industrial society. These constitute a useful frame of reference for a serious attempt at tackling the problem of conventional environmental pollution, which has never been attacked on an overall basis, but only by a series of rules and laws which are neither adequate nor sufficient to guarantee the survival of society in an environment whose biological equilibrium is ever more seriously disturbed. Thus the criteria and methods of radioecology are reviewed, and their applicability to the study and control of other types of environmental pollution (chemical, bacteriological) is emphasized in each case. Attention is drawn to the illogicality of confining a precious technological and human potential such as that of nuclear engineering within the restricted bounds of control of a risk, that of radioactive pollution, which at the present time appears extremely limited in comparison with the much more serious ecological catastrophe attributable to the conventional sector. (auth)

5278 (EUR–4800(Vols.1 and 2), pp 745-58) USE OF INFORMATION FROM RADIOECOLOGICAL RESEARCH RELATING TO METAL ACTIVATION PRODUCTS FOR THE STUDY OF THE TRANSFER OF METALLIC OR ORGANOMETALLIC CHEMICAL POLLUTANTS TO MAN. Bittel, R. (CEA, Fontenay-aux-Roses, France). May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Results of a study of a case where pollution is discharged into water and transferred by food to man are presented. The extension to the case of chemical pollution of a model proposed for that of radioactive pollution shows that, as regards the environment, these two aspects of pollution can be treated, as a rule, in parallel. Examples taken from the recent scientific literature, relating to zinc, cobalt, chromium, mercury, and their radioisotopes define the analogy. While radioecological studies constitute an aid to those of chemical pollution, the problems considered within the latter lead to certain aspects of radioecology, in particular the physicochemical aspects, being considered in a more precise fashion. (auth)

5279 (EUR–4800(Vols.1 and 2), pp 773-7) RADIOECOLOGY AND CHEMOECOLOGY IN THE SERVICE OF THE PROTECTION OF NATURE. Polikarpov, G. G.; Kulebakina, L. G.; Tsitsugina, V. G.; Andrudtschenko, V. V. (Inst. of Biology of South Seas, Sevastopol, USSR). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Mankind exerts an increasing influence on the environment, discharging into the biosphere the toxic products resulting from industrial activities and superpower weapon tests. Radioactive substances have a new and increasing importance in the environment. Despite a sharp decrease in the quantity injected into the environment (as a result of the ban on atmospheric nuclear tests), the concentration of some radionuclides, ^{90}Sr for example, keeps growing in a number of regions of the biosphere. Thus, seas having a small water exchange with oceans are characterized by a continual, though slow, growth of the ^{90}Sr content in the water and in aquatic organisms. Radionuclides such as ^{90}Sr, ^{90}Y, ^{91}Y, ^{137}Cs, and ^{14}C act destructively on genetic structures, causing an increase in the frequency of chromosome aberrations, for example, in the cells of sea fish embryos. The strongest cytogenetic action is the same as that of radioyttrium and is most probably connected with its capacity to be concentrated by organisms. Serious attention should be paid to the wide distribution of chemical weed and pest-killers in the biosphere. In the Black Sea, significant traces of chloroorganic pesticides were found. They are strongly concentrated by organisms. The concentration factors in fish for DDT and DDE are respectively of 180,000 and 100,000. The growth of the electronuclear power and of the chemical industry opens new and urgent fields for radioecology and chemoecology in the protection of the environment. (auth)

5280 (EUR–4800(Vols.1 and 2), pp 869-90) TRANSFER TO MAN, THROUGH HIS FOOD, OF THE RADIOISOTOPES OF RUTHENIUM, COBALT, AND ZINC DISCHARGED INTO CONTINENTAL WATERS. Bittel, R. (CEA, Fontenay-aux-Roses, France); Merlini, M.; Beque, H.; Berg, A.; Myttenaere, C.; Ravera, O.; Verot, J. L.; Van Der Borght, O. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

On the basis of certain assumptions, the dose delivered to man by the ingestion of food contaminated by radioactive pollution of water can be evaluated in any situation. The use of a type of standard calculation is described for aquatic food chains in order to establish the consequences for man of the contamination of continental waters by radioruthenium and metallic activation products, in particular, radioisotopes of cobalt and zinc. A study of examples based on the results of food surveys and of experiments performed mainly at Ispra and Mol indicates the doses reaching man in different cases and permits estimation of the incidence of variations of some of their parameters. (auth)

5281 (EUR–4800(Vols.1 and 2), pp 977-87) CONTRIBUTION OF A PREDICTION MODEL TO THE ESTABLISHMENT OF FORMULAE FOR THE DISCHARGE OF RADIOACTIVE EFFLUENT INTO WATER. Bittel, R. (CEA, Fontenay-aux-Roses, France). May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

A discussion is presented on the extent to which a model proposed for the evaluation of the dose delivered to man following the ingestion of food contaminated by polluted waters can be used for the establishment of discharge formulas. This model is expressed by a simple relation between the "ingestible dose," the quantities of each food ingested by the populations concerned, the transfer factors from the water to the foods for the various radionuclides, and the levels of pollution of the water. If these levels can be expressed as a function of the quantities of radionuclides discharged during a given period, the above relation constitutes a discharge formula which takes account explicitly of the eating habits of the populations concerned and the transfer factors of the pollution from the environment to the foods consumed by man. The conditions of practical application of these concepts and their extension to the case of chemical pollution are briefly discussed. (auth)

5282 (EUR–4800(Vols.1 and 2), pp 989-1013) CONTAMINATION BY RAIN (^{90}Sr, ^{137}Cs) OF PARTS OF CROPS ABOVE GROUND. Lehr, J. (EURATOM-CEA, Fontenay-aux-Roses, France); Myttenaere, C. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

A model is proposed allowing the rate of transfer to be estimated for direct contamination of standing crops by fallout as a result of rain. It is based on results of factorial tests with contamination of plants by spraying, the variables being the quantities of water, the duration and composition of the water. It is also based on the rainfall regime (number of precipitations and intensity) during the period of growth and on the relative specific activity, as a function of the height of the falls of rain, and on the mean temperature during the summer period. Application of the model to three clearly differentiated climates occurring in the Federal Republic of Germany, at Ispra, and at Rome makes it possible to evaluate, as a function of the climatic conditions, the variability of the rates of transfer of the contamination from the rain to the plant. (auth)

5283 (EUR–4800(Vols.1 and 2), pp 1023-38) MONITORING OF ^{90}Sr IN THE AIR–RAINWATER–SOIL–GRASS–MILK CHAIN. Bezzegh-Galantai, M. M. (Eidgenoessische Technische Hochschule, Duebendorf, Switzerland). May 1972. (In German).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Since 1958 periodic measurements of ^{90}Sr have been made in air (filter residue), rainwater, soil, grass, and milk samples taken from regions in Switzerland representing various altitudes and precipitation intensities. The variations in radioactivity were caused by atmospheric A-bomb testing. While a statistically significant correlation of the ^{90}Sr content of the air and rainwater was found, no clear relationship between the ^{90}Sr radioactivity of the soil (uppermost layers) and that of grass could be detected. The variations in the radioactivity of grass paralleled those of the air and rain, but no similar increase or decrease in the soil was observed. In the light of this it was concluded that plants become contaminated mainly from the atmosphere and not from the soil. There was also a clear correlation between the radioactivity of the milk samples and that of grass: the relation of the concentration in milk (pCi/l) and that of grass (pCi/kg dry solids) corresponds to values of between 0.01 and 0.04. The specific ^{90}Sr activity of milk, judging by the conditions observed between 1964 and 1969, is only a small percentage of that of grass. A comparison between the ^{90}Sr concentration in milk (pCi/l) and rainwater (pCi/l) showed that the radioactivity of the milk was always several times higher than that of the rainwater. (auth)

5284 (EUR-4800(Vols.1 and 2), pp 1103-20) EXPERIMENTAL CONTAMINATION OF SOME SPECIES CULTIVATED WITH THE AID OF EFFLUENTS OF VARIOUS SOURCES. Delmas, J.; Bovard, P.; Grauby, A.; Disdier, R. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

As a continuation of studies, the aim of which is to show the connection between water contamination and the contamination of edible agricultural produce, experiments have been performed to evaluate the effect of radionuclides discharged into rivers from various sources on crops. Samples from industrial installations such as processing stations and electro-nuclear power-houses, and substances prepared in the laboratory such as ^{60}Co sequesters with EDTA and ^{54}Mn in chloride form were used as contaminants. The plants were contaminated either by watering the ground with water to which radioactive residue had been added, or by spraying the aerial organs of the plants. The results obtained are discussed and analyzed. The long-term effects of radionuclides used on crops, especially considering their source, nature, and the means by which they reach the crops, are emphasized. (auth)

5285 (EUR-4800(Vols.1 and 2), pp 1135-51) RADIOECOLOGY OF ^{22}Na, ^{210}Po, AND ^{210}Pb IN THE UNIQUE FOODCHAIN: LICHEN-REINDEER-MAN. Mattsson, L. J. S.; Persson, R. B. R. (Univ., Lund, Sweden). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The lichen-reindeer-man food-chain was studied for several years as a model system for obtaining information on factors of transfer for radionuclides from deposition to reindeer diet and from reindeer diet to man. Sodium-22, which is naturally produced in the atmosphere, was also introduced there in relatively large amounts by thermonuclear detonations in 1961 and 1962. The main source of ^{210}Pb in the atmosphere is naturally-produced ^{222}Rn, which is exhaled from the ground. The ^{22}Na-, ^{210}Pb- and ^{210}Po-contents of lichen-carpets (Cladonia alpestris), reindeer-tissues, and human blood were investigated during the period from 1961 to 1970. The radioactivity concentration of ^{22}Na in reindeer-flesh rose rapidly from about 1 to 10 pCi per kg to a maximum value of 200 pCi per kg wet weight in late 1964. A mathematical model describing the ^{22}Na-transport from reindeer-blood to -bone is given. The ^{210}Pb-activity concentration found in different tissues of reindeer slaughtered in March 1970 and 1971 varied from 3100 pCi per kg wet weight in bone to 12 pCi per kg wet weight in meat. Blood samples from Lapps engaged in reindeer breeding were also analyzed. (auth)

5286 (EUR-4800(Vols.1 and 2), pp 1213-19) RE-EXAMINATION OF PLUTONIUM AT THULE, GREENLAND, IN 1970. Aarkrog, A. (Danish Atomic Energy Commission Research Establishment, Risoe, Denmark). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

After the accidental release of plutonium at Thule in January 1968 a radioecological study was carried out in the following summer. Increased plutonium levels appeared in samples collected as far as 15 kilometers from the point of impact. Especially bottom animals showed increased levels. To investigate the distribution as well as the migration of plutonium in the food-chains at Thule a re-examination was undertaken in August 1970. As in 1968 samples of seawater, bottom sediments, bottom animals, zooplankton, fish, seabirds, seals, seaplants, and lichen were collected. The investigation showed that although the levels in most samples had decreased since 1968 plutonium was still present in concentrations significantly above the fallout background. Samples of bottom sediments showed a vertical movement of plutonium in the sediments down to a depth at least 10 cm. Bivalves as far as 30 kilometers from the point of impact contained plutonium from the accident. (auth)

5287 (EUR-4800(Vols.1 and 2), pp 1345-56) BEHAVIOR OF REACTOR EFFLUENT ACTIVITIES IN THE PRODUCTION OF SEA SALT BY SOLAR EVAPORATION. Sankhesara, B. M.; Kamath, P. R. (Bhabha Atomic Research Centre, Bombay). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

In the vicinity of Tarapur Atomic Power Station, sea salt is produced by solar evaporation in exposed earthen pans. Sea water is allowed to collect into reservoirs in high tide, from which it is channeled into different pans to produce crude or white variety of salt. The crude salt is consumed by the local people while white varieties are exported to cities. The reactor effluents are discharged close to the shore and can reach the salt pans mixed with tidal flows in a single tide. In addition, tidal oscillations are a natural phenomenon in the coastal area which indicate possibilities of contamination build up and carry over. In-flowing tidal streams are slowed down and are held in reservoir so that flocks of silt and weeds gradually settle down; the waters are led from pan to pan as chloride content increases and unwanted salts deposit on bed. These are processes promoting decontamination. Sodium chloride itself has low solubility and crystallizes out before other chlorides crystallize. Cesium chloride is 100 times more soluble than sodium chloride. Spiked sea water studies are reported which throw considerable light on the behavior and distribution of discharged radionuclides in salt pans. Results show most reactor-produced activities are retained by settling silt. Strontium activity in salt is dependent upon impurities present in the final crystal (crude or pure). ^{137}Cs is mostly contained in the mother liquor left after harvesting the salt crop. These studies have been followed by chemical examination of operating salt pans at site. (auth)

5288 CONTROL OF RADIOACTIVITY IN MILK IN THE FEDERAL REPUBLIC OF GERMANY. Knoop, E.; Kraemer, R.; Wiechen, A. (Bundesanstalt Milchforsch., Kiel). Kiel. Milchwirt. Forschungsber.; 22: No. 3, 303-15(1970). (In German).

Information is presented on the importance of milk as an indicator of environmental radioactivity, results of tests during the past 15 years, pathways of contamination by various radionuclides, and prospects for decontamination. (Euratom)

5289 DATA, SECTION I, MILK AND FOOD. Radiat. Data Rep.; 13: No. 8, 425-34(Aug 1972).

Tabulated data on the ^{137}Cs and ^{90}Sr content in milk sampled at 84 locations in the Western Hemisphere (Canada, Central America, South America, and the US) are presented for April 1972 and for the period from May 1971 to May 1972. April 1972 data on the ^{140}Ba, ^{131}I, and ^{89}Sr content in milk sampled at 23 US stations are also included. (L.C.L.)

5290 ENVIRONMENTAL CONTAMINATION AND HUMAN FOOD AND BODIES. Tsugo, T. (Tokyo Univ.). pp 111-88 of Studies on Radiation Effects. /Hiyama, Yoshio (ed.). Tokyo; Tokyo Daigaku Shuppankai (1971). (In Japanese).

Analytical studies of radionuclide kinetics in the soil, agricultural products, live-stock products, and marine products as well as in human tissues had been hardly made systematically before 1954 when the hydrogen bomb was tested in Bikini Islands. The survey on contamination and decontamination of radionuclides mainly in the soil and agricultural products were conducted throughout Japan during 15 yrs from 1954 to 1968 by research groups from seven Japanese universities. One group reported that the mean content value of ^{90}Sr in the cultivated soil in Tokyo reached 2.1 mCi/km^2 in 1961, 8.1 mCi/km^2 in 1962, 19.1 mCi/km^2 in 1963, and then decreased to 8.6 mCi/km^2 in 1964, although the testing of nuclear weapons was banned in 1958. It is suggested that radioactive particles tend to remain or migrate for considerable periods of time. Further studies were carried out on chemical analysis of these radioactive substances. As reported in the "Radioactivity Survey Data in Japan" No. 1 to No. 20 (1963 to 1968), the maximum value of ^{90}Sr and ^{137}Cs were 81.0 pCi/gCa (89.1 pCi/l) and 650 pCi/gk (975 pCi/l) respectively in fresh milk, and 97.1 pCi/gCa and 674.7 pCi/gK in powdered milk. Experimental studies of biological effects and toxicity of radionuclides on domestic animals, milk products, and marine products were carried out along with the survey. Radionuclides detected in the marine products in the Japanese sea coast were ^{55}Fe, ^{59}Fe, ^{113m}Cd, and ^{115}Cd. The survey on geographical deposit of these substances was made and statistical analysis was presented in the table. In reviewing study reports on environmental contamination and contaminated food in particular, it is suggested that further studies should be carried out in determining the maximum permissible dose, presence and absence of radioisotope carriers, concentration factors, and the maximum range of contamination of our environment from the ecological point of view. (Japan)

5291 LOGICAL APPROACHES TO POWER SUPPLY AND ENVIRONMENT. Woodson, R. D. (Black and Veatch Consulting Engineers, Kansas City, Mo.). J. Power Div., Amer. Soc. Civil Eng.; 98: No. PO2, 181-6(Oct 1972).

As American environmental practice becomes more mature, most environmental considerations will be established during the preliminary planning of a project. The necessary analyses, reports, coordination with advisory and regulatory bodies, and acquisition of permits should and most likely will be accomplished at the outset of the project. Engineering practices related to environmental considerations will be well established and will become a routine part of engineering assignments as contrasted to the rather poorly defined practices existing at this time. The recent court decision in the Calvert Cliffs Nuclear Plant case requires the AEC, in their licensing procedures, to evaluate the total environmental impact in terms of available alternatives.

This decision emphasizes the need for timely action. Despite the somewhat confused situation and precipitate emphasis on environmental considerations, professional engineers continue to endorse the need for well considered approaches to a good environment. (auth)

Radiometric Techniques

Refer also to abstract 5364.

5292 (EUR–4800(Vols.1 and 2), pp 703-19) METHOD TO STUDY THE HISTORY OF ANY PERSISTENT POLLUTION IN A LAKE BY THE CONCENTRATION OF ^{137}Cs FROM FALLOUT. Ravera, O.; Premazzi, G. (CCR, Ispra, Italy). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

A method was developed for the measurement of the sedimentation-rate on lake bottoms. That is, the amount of material deposited in one year per unit of surface. Fifty-three core samples were taken at the maximum depth of 5 lakes in Northern Italy: Comabbio, Maggiore, Monate, Orta, and Varese. Each core was sliced in layers of 4 cm thick and the ^{137}Cs activity from fallout was measured, using a Ge–Li semiconductor spectrometer. Total beta activity was measured on layers of 1 cm thick. From these results it was possible to determine the amount of ^{137}Cs accumulated on the lake bottom in one year and hence, the amount of any nonradioactive persistent pollutant sedimented in one year. As a consequence, this method can be utilized to study the history of pollution of a lake, and particularly, after a waste treatment plant has been installed near a body of polluted water. (auth)

5293 (EUR–4800(Vols.1 and 2), pp 735-43) TERMINOLOGICAL ASPECTS OF THE CONCEPT OF THE ENVIRONMENT AND ITS PROTECTION. Ternisien, Jean A. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The agents which characterize the environment operate in the biosphere and affect man in his ecological medium. It is therefore important to arrive at precise linguistic definitions to express concepts which ultimately bear upon the fundamental approach to the action. The definitions established by the international group on Environment-Nuisances of the Conseil International de Langue Française are explained. (auth)

5294 SOME NEW METHODS FOR STUDYING CORE SAMPLES OF MARINE SEDIMENTS. Ottmann, F. (Univ., Nantes, France). Rev. Inst. Fr. Petrole Ann. Combust. Liquides; 27: No. 3, 407-19(May 1972). (In French).

The analysis of marine sediments is discussed. Methods specially adapted to mud are presented including the obtaining of core samples from mud flats, radiography, gamma densimetry, acoustic tests on unopened core samples, and lyophilization for the analysis of muds by thin sections or scanning electron microscopy. In addition, the advantages of using radiography in conjunction with gamma densimetry for selecting samples and orientating further studies are discussed. (France)

Site Surveys

Refer also to abstract 5254.

5295 (WASH–1226-23) ONSITE METEOROLOGICAL PROGRAMS. Safety Guide. (Directorate of Regulatory Standards (AEC), Washington, D. C.). 17 Feb 1972. 6p. Dep. DRS, USAEC, Washington, D. C.

5296 NUCLEAR POWER GENERATION IN WESTERN EUROPE: SAFETY AND ENVIRONMENTAL IMPLICATIONS. Schuster, G. (Commission of the European Communities, Brussels); Vinck, W.; Boos, H.; (and others). Trans. Amer. Nucl. Soc.; 15: No. 2, 645-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Thermal Effluents

Refer also to abstracts 5400, 7094, and 7107.

5297 (EUR–4800(Vols.1 and 2), pp 689-702) THERMAL POLLUTION OF RIVERS IN THE COUNTRIES OF THE EUROPEAN COMMUNITY. d'Hoop, H. (Commission des Communautes Europeennes, Brussels). May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Thermal electric power stations need a cold source for the transfer of a large quantity of heat: this problem is more acute in nuclear power stations because of their large economic size, 1000 Mw(e), and lower thermodynamic output. Up to now, financial considerations have obliged most thermal power stations to use the rivers as cold sources for the disposal of excess heat. In countries belonging to the European Community, the heating of rivers cannot at present be regarded as a case of pollution (with one or two exceptions). But taking in consideration the rate of growth in the demand for electrical energy (expected to double in about ten years), the heat absorption capacity of European rivers will constitute a limiting factor in the acquisition of new sites or construction of new power stations. The problem for the countries of the Community is reviewed along with aspects of the technical and economic consequences of this situation. The discussion is focused on the main lines of research which may be pursued as a result. (auth)

5298 (TID–26216) FISHES OF LOWER THREE RUNS CREEK AND THE PAR POND RESERVOIR SYSTEM OF THE SAVANNAH RIVER PLANT, SOUTH CAROLINA. Clugston, J. P. (Georgia Univ., Athens. School of Forest Resources). 1972. 14p. Dep. NTIS.

A comparison was made of the number and species of fish in the cooling reservoirs for Savannah River reactor wastes (Par Pond) and other ponds in the area. No effects of thermal effluents on the relative abundance and standing crops of fishes in the cooling reservoirs were observed. (C.H.)

5299 BIOLOGICAL ASPECTS OF THERMAL POLLUTION. II. SCIENTIFIC BASIS FOR WATER TEMPERATURE STANDARDS AT POWER PLANTS. Coutant, C. C. (Oak Ridge National Lab., Tenn.). CRC Crit. Rev. Environ. Contr.; 3: No. 1, 1-24(Aug 1972).

The effects of thermal discharges from electric generating power plants are examined. Discussions are included on importance of temperature, thermal limitations of aquatic organisms, and methods of temperature criteria development. Data tables are included on thermal resistance of various North American aquatic species. Examples of temperature criteria are also included. (J.R.D.)

5300 IMPACT OF COOLING WATER ON LAKE TEMPERATURES. Stefan, H.; Chu, C. S.; Wing, H. (Univ. of Minnesota, Minneapolis). J. Power Div., Amer. Soc. Civil Eng.; 98: No. PO2, 253-72(Oct 1972).

The physical effects of heated water discharges in a specific impoundment are described. The site selected for this study is Lake St. Croix, Minn., and the time period 1969–1970. The lake receives cooling water discharges from the 550-MW Allen S. King thermal power generating plant, which has been in operation since 1968. (J.R.D.)

5301 INTEGRATED WATER SYSTEM FOR POWER PLANTS AND PUBLIC WATER SUPPLY FOR WASTE HEAT DISPOSAL. Brown, H. L.; Hamel, B. B. (Drexel Univ., Philadelphia). Trans. Amer. Nucl. Soc.; 15: No. 2, 649-51(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5302 NUMERICAL COMPUTATION OF WASTE-HEAT DISPERSION IN A RECEIVING WATER BODY. Kolesar, D. C. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 651-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 4935, 4984, 5092, and 5389.

5303 (CERN-72-12) EXPERIMENTAL CALIBRATION AND CALCULATION OF IONIZATION CHAMBERS WITH AIR CIRCULATION. Peetermans, A. (European Organization for Nuclear Research, Geneva (Switzerland)). 4 Jul 1972. 30p. (In French). Dep. NTIS (U. S. Sales Only).

The method followed for the calibration of different ionization chambers with air circulation used in the Groupe Physique de Sante is described. The calculations were made with respect to the isotopes ^{11}C, ^{13}N, ^{15}O, ^{41}Ar, ^{14}O, ^{38}Cl, ^{85}Kr, ^{133}Xe, ^{14}C, and T. The energy spectrum of the β particles is calculated from the function of the probability density which depends on the total maximum energy of the particles emitted in the n^{th} transition and on the atomic number of the daughter product. Comparison of the calculated values with experimental values showed that for average β energies, above 250 to 300 keV, the ionization current of the chamber can be calculated with a precision of 10 to 15% if the emitter detected is known. Below these energies the calculation method applied is no longer valid and should be replaced by a Monte Carlo calculation. (J.S.R.)

5304 (GULF-RT-B-12155) PROTON-RECOIL PROPORTIONAL COUNTER FOR NEUTRON SPECTROMETRY IN FAST REACTORS. Verbinski, V. V. (Gulf Radiation Technology, San Diego, Calif.). 16 Oct 1972. Contract AT(04-3)-167. 128p. Dep. NTIS.

Reported are (1) a study of the hydrogenous proportional counter response to neutrons and background gamma rays, (2) counter applications for measuring fast-reactor spectra, (3) a critical survey of spectrum-unscrambling codes, and (4) a comparison of the results with transport calculations and time-of-flight measurements. To assess the accuracy of the proton-recoil spectrometry method, the responses of two basic types of proportional counters were measured, and the resultant experimentally determined response-function shapes are compared with analytical calculations. The basic analytical equations used to calculate the response functions correct for the finite recoil-proton track length, and are an integral part of two spectrum-unscrambling codes heretofore in wide use. Additional counter distortions are added to these analytical calculations as part of this program. The response function measurements also provide data on the relationship between energy and ionization that is needed to set the energy scale and to correct for a multiplicative factor in the raw data when this relationship is not totally linear. These corrections are important at low neutron energies. In addition to the two spectrum-unfolding codes now in widespread use for proportional counter spectrometry, other analysis codes are applied to this problem for the first time, and a comparative study made of these codes when applied to the same reactor spectrum. Not only the unscrambling methods, but the type of basic counter was varied in making measurements of fast-reactor spectra. Both cylindrical and spherical counters were used and the results for the same reactor region compared. The proton-recoil spectra are compared with transport calculations of scalar-flux spectra for the STSF-7 and STSF-9 subcritical assemblies. For the same assemblies, time-of-flight spectra are compared with calculated spectra of angular flux. Any departures of the calculation from either of the measured spectra can be used in diagnostics of the transport calculation and the input cross-section set. (auth)

5305 (LBL-1214) EFFICIENCY OF DETECTING A ^{8}Be WITH A $\Delta E-E$ COUNTER TELESCOPE. Harney, H. L.; Wozniak, G. J. (California Univ., Berkeley. Lawrence Berkeley Lab.). Sep 1972. Contract W-7405-eng-48. 30p. Dep. NTIS.

A formalism is derived for calculating the probability, ϵ, of detecting a ^{8}Be event with a single $\Delta E-E$ counter telescope. Both the cases of a solid and of a gas target are treated. To evaluate ϵ a FORTRAN program is presented. In addition, a simple formula for ϵ is derived which holds in the limit of "small" geometric solid angles. (7 figures, 2 tables) (auth)

5306 (UCRL-51288) POSITRON/SCINTILLATION CAMERA DATA ACQUISITION AND DISPLAY SYSTEM. Behrin, Ervin (California Univ., Livermore. Lawrence Livermore Lab.). 20 Oct 1972. Contract W-7405-eng-48. 17p. Dep. NTIS.

A Positron/Scintillation camera data acquisition and display system located at the LLL 100 MeV Linear Accelerator facility is described. The camera consists of two identical 16-in. diam Anger Scintillation detectors. The camera outputs are sampled, digitized and routed through a PDP-15 computer onto a high-speed drum storage device. A software operating and display system has been developed. Some applications are described. (auth)

5307 POSITION SENSITIVE RESPONSE OF A THIN FILM DETECTOR TO THE PASSAGE OF ALPHA PARTICLES. Muga, L. (Univ. of Florida, Gainesville). Nucl. Instrum. Methods; 105: No. 1, 61-3(1972).

The position-sensitive nature of the thin film detector (TFD) was established by digitally recording the two signal responses produced by two opposing photomultiplier (PM) tubes when a collimated alpha particle beam impinged upon defined areas of the thin film scintillator. The observed differential response is consistent with a mechanism of light collection in which light is "trapped" and guided to the PM faces within the scintillator film itself, undergoing an exponential-type decrease in intensity per path length. An additional mechanism may contribute appreciably, and this is characterized by light emitted in an isotropic (4π) distribution about the point at which the alpha particle traverses the film. The resolution of the position-sensitive response is relatively poor, due in part to the weak signals generated by the traversing light ions. The position response curves indicate how improved signal strengths can be obtained by redesign of the scintillator film support. (5 figures) (auth)

5308 INFLUENCE OF STRONG MAGNETIC FIELDS AND TEMPERATURE ON THE PULSE RISE TIME IN PLANAR Ge(Li)-DETECTORS. Feigelbinder, H.; Weber, H. W. (Oesterreichische Hochschule, Vienna). Nucl. Instrum. Methods; 105: No. 1, 65-8 (1972).

A theoretical study on the drastic increase of the pulse rise time observed previously in strong transverse magnetic fields is presented. The drift velocities of electrons and holes are calculated as a function of the magnetic field, the temperature, and the electric field. With the aid of these results a simple, one-dimensional detector model is applied to calculate the pulse rise time. The results compare favorably with experiments at 77 K. (7 figures) (auth)

5309 HIGH EFFICIENCY FAST RESPONSE DETECTOR FOR 14 MeV NEUTRONS. I. EXPERIMENTAL. Shaanan, M. (Soreq Nuclear Research Center, Yavne, Israel); Friedman, E. Nucl. Instrum. Methods; 105: No. 1, 69-71(1972).

A small, spherical neutron detector made of NE102A plastic scintillator was used for flux measurements of 14-MeV neutrons. Its absolute efficiency was measured by two independent experiments and compared to Monte Carlo calculations. Gamma rays of up to about 7 MeV can be rejected by introducing a sufficiently high threshold. This high-efficiency, fast-response detector is most suitable for monitoring 14-MeV neutron sources in activation experiments. (1 figure, 1 table) (auth)

5310 HIGH EFFICIENCY FAST RESPONSE DETECTOR FOR 14 MeV NEUTRONS. II. EVALUATION BY THE MONTE CARLO METHOD. Adir, J.; Katz, S.; Salmi, U. (Hebrew Univ., Jerusalem). Nucl. Instrum. Methods; 105: No. 1, 73-5(1972).

A special-purpose computer code was written to evaluate the efficiency of a fast neutron detector by the Monte Carlo method. It is a one-dimensional, spherical-geometry program, with pointwise neutron cross sections, taken from the ENDF/B data file. The computed efficiency compares very favorably with experimental results. (3 figures, 2 tables) (auth)

5311 MATERIALS FOR SEMICONDUCTING RADIATION DETECTORS. Giriat, Witold (Inst. of Physics, Warsaw). Postepy Fiz.; 23: No. 4, 329-50(1972). (In Polish).

Some properties and methods of preparation of CdTe used in the technology of nuclear radiation semiconducting detectors and in the technology of semiconducting infrared detectors are discussed. Mixed crystals of mercury chalcogenides and lead chalcogenides are discussed as a material for the infrared radiation detectors. A short review of some materials used in infrared technology is also given. (auth)

5312 SEMICONDUCTOR DETECTORS OF NUCLEAR RADIATION. Chwaszczewska, Janina (Inst. of Nuclear Research, Swierk, Poland). Postepy Fiz.; 23: No. 4, 351-68(1972). (In Polish).

A survey on the technology and properties of semiconducting detectors for nuclear radiation is given. Germanium, silicon and cadmium telluride detectors are discussed. (auth)

5313 APPLICATIONS OF THE SEMICONDUCTOR NUCLEAR DETECTORS. Slapa, Mieczyslaw (Inst. of Nuclear Research,

Swierk, Poland). Postepy Fiz.; 23: No. 4, 429-44(1972). (In Polish).

Semiconductor nuclear detectors in many fields of physics, chemistry, medicine and industry are discussed. A survey of some important parameters of these detectors is also given. (auth)

5314 APPARATUS PG-1 FOR THE STUDY OF THE RADIATION CHARACTERISTICS IN THE NEIGHBORHOOD OF THE EARTH BY SATELLITE INTERCOSMOS 3. Vesely, V.; Sicha, M.; Laska, L.; (and others) (Charles Univ., Prague). Bull. Astron. Inst. Czech.; 23: No. 5, 293-7(1972).

The electronic PG-1 apparatus, which was placed on Earth-satellite Intercosmos 3, is described. The system consists of arrays of semiconductor and G-M counters for measuring the energy spectra of protons from 1 to 30 MeV and electrons above 40 keV and the primary background component of the cosmic radiation. A block diagram of the PG-I apparatus is presented. (W.H.K.)

5315 VARIATIONS IN THE RADIOLUMINESCENT YIELD OF ORGANIC SCINTILLATORS WITH ENERGY LOSS AND THE NUMBER OF CHARGES POSSESSED BY THE INCIDENT CHARGED PARTICLES. Lopes da Silva, J.; Voltz, R. (Centre National de la Recherche Scientifique, Strasbourg). Rev. Phys. Appl.; 7: No. 2, 127-32(Jun 1972). (In French).

An experimental study of the relative scintillation response of organic materials to different types of radiation is presented. The overall scintillation and its two components (prompt and delayed) are considered separately. An original device enables the number of photons emitted (either throughout the entire scintillation or in the delayed component) when a charged particle traverses a thin sheet of plastic scintillator to be measured. A large number of different radiations (electrons, protons, deuterons, tritons, α particles, $^3He^{++}$ ions and nitrogen) were used, particular attention being given to energy regions where the ionizing power is high. The results obtained demonstrate that the scintillation yield together with the two components depend on the number of charges and the specific energy loss experienced by the particles. The experimental data agree with recently proposed theoretical expressions. (France)

5316 PITFALL IN THE USE OF POLYETHYLENE VIALS IN LIQUID SCINTILLATION COUNTING. Johanson, K. J.; Lundqvist, H. (Univ. of Uppsala). Anal. Biochem.; 50: No. 1, 47-9 (Nov 1972).

The continuous drift of the external standard channel ratio when using polyethylene vials in liquid scintillation counting was studied. It is proposed that this drift is due to the migration of the scintillators into the walls of the vials. Experimental results are given. (W.H.K.)

5317 ANALYTICALLY DETERMINED RESPONSE OF A 300-μm SILICON DETECTOR TO A POLYENERGETIC BEAM OF NEUTRONS. Taherzadeh, M. JPL Quart. Tech. Rev.; 1: No. 2, 119-30(Jul 1971).

The response of a 300-μm silicon detector to an incident polyenergetic neutron beam emitted from a plutonium dioxide fuel power source was determined. The results indicate that the response of the detector is basically due to elastic scattering reactions, and the contribution from other reactions is very small. For neutron energies greater than 4.5 MeV, the (n,p) and (n,a) reactions contribute less than 2% to the total response. The maximum response for this detector is less than 4×10^{-3} counts/neutron within the range of bias energies of 25 to 250 keV. Moreover, this maximum value will decrease if consideration is given to the pulse height defect phenomenon. (auth)

5318 SELF-STUDY COURSE IN RADIATION MEASUREMENTS AND ANALYSIS. Long, R. L. (Univ. of New Mexico, Albuquerque). Trans. Amer. Nucl. Soc.; 15: No. 2, 636-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5319 CURRENT AND POTENTIAL APPLICATION OF CdTe RADIATION DETECTORS. Palms, J. M. (Emory Univ., Atlanta). Trans. Amer. Nucl. Soc.; 15: No. 2, 698-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5320 NEW COLLIMATOR DESIGN BASIS IMPROVES GAMMA SCINTILLATION CAMERA PERFORMANCE. Simmons, G. H.; Christenson, J. M.; Keriakes, J. G.; Bahr, G. K. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 15: No. 2, 716-17(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5321 PREPARATION AND HANDLING OF MINIATURIZED NEUTRON MONITORS FOR HIGH-LEVEL FLUX-SPECTRA-FLUENCE CHARACTERIZATION. Ulseth, J. A.; Jackson, J. L.; Combs, B. L. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 767-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5322 EFFECTS OF GAS COMPOSITION ON GAMMA PERFORMANCE OF FISSION COUNTERS. Hoitink, N. C.; Wood, M. R. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 871-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5323 GAMMA COMPENSATED PULSED ION CHAMBER NEUTRON FLUX/REACTOR POWER MEASUREMENT SYSTEM. Ellis, W. H.; Cooper, J. L. Jr.; Sanders, G. H. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 15: No. 2, 874-5 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5324 MONTE CARLO CALCULATION OF THE NEUTRON SENSITIVITY OF SELF-POWERED DETECTORS. Goldstein, N. P. (Westinghouse Research Lab., Pittsburgh). Trans. Amer. Nucl. Soc.; 15: No. 2, 981-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5325 PHOTOMETRIC CHARGE DISCRIMINATION OF NONRELATIVISTIC HEAVY COSMIC IONS IN NUCLEAR EMULSION. Sequeiros, J. (Univ. Autonoma de Barcelona, Bellaterra, Spain); Fernandez, F.; Kaiser, R.; Gandia, V. Nucl. Instrum. Methods; 104: No. 3, 469-75(1972).

A procedure for photometric charge discrimination in nuclear emulsion is described. From the measurements taken at the end of the range of tracks on protons and α-particles of 150 MeV and 100 MeV respectively, a function of the form $\sum_0^R Op(Z, R) = (aR + b)Z^x$ has been determined. From this the values of the charges of ten nonrelativistic heavy cosmic ions ($6 \lesssim Z \lesssim 26$) have been obtained with an error which at its worst ($Z \approx 26$) has been ± 1 unit of charge. (auth)

5326 MONTE CARLO CALCULATIONS OF RELATIVE EFFICIENCIES OF Ge(Li) DETECTORS. Peterman, B. F.; Hontzeas, S.; Rystephanick, R. G. (Univ. of Saskatchewan, Regina). Nucl. Instrum. Methods; 104: No. 3, 461-8(1972).

By means of a Monte Carlo computer program the relative full energy peak efficiency and relative double escape peak efficiency for gamma rays of a cylindrical Ge(Li) detector with volume of 50 m^3, a rectangular Ge(Li) detector with volume of 30 cm^3 and a trapezoidal Ge(Li) detector with volume of 50 cm^3 has been calculated. The gamma source was assumed to be a point placed 10 cm from the detector. The calculated efficiency curves for the cylindrical detector were compared with the curves experimentally obtained by other authors. The agreement was found to be within quoted errors. The calculated efficiency curves of all three detectors have been used to determine the gamma ray relative intensities in the decays of ^{22}Na, ^{60}Co, ^{56}Co and ^{226}Ra. It has been found that the relative intensity values of gamma rays for the above sources can be reproduced within 5%. (auth)

Radiation Dosimeters

Refer also to abstracts 5494, 5497, 5501, and 5522.

5327 (HASL-265) INVESTIGATION OF THERMOLUMINESCENT DOSIMETERS FOR ENVIRONMENTAL MONITORING. Burke, G. de P.; Shambon, Arthur (Health and Safety Lab. (AEC), New York). Oct 1972. 15p. Dep. NTIS.

An investigation was made of the feasibility of using commercially produced LiF and glass encapsulated CaF_2 : Mn thermoluminescent dosimeters for low level environmental radiation monitoring. The study included extensive laboratory testing of the performance of both types of dosimeters at exposure levels of 1 to 10 mR which is the range of exposures encountered in environmental monitoring over periods of 1 to 5 weeks. The dosimeters were tested for accuracy, precision, sensitivity, response to dose, directional dependence, fading and self-irradiation. A standard handling and analysis procedure was devised, based on the parameters studied. The validity of the system was verified by the results of 1 mR trial exposures in a known laboratory radiation field. Extensive environmental measurements were subsequently carried out at two nuclear power stations. At one station monthly data were accumulated at seven locations for about one

year. The month-to-month variations were for the most part less than 20% with the exception of June to July in 1971 where a 30% change was observed. At the second station, data were accumulated at 12 locations for one month under normal reactor operating conditions and for a second period of five weeks during a shutdown. At locations nearest the power station, the average dose rates inferred from the first exposure period were slightly greater than the average dose rates during shutdown. (auth)

5328 (NP-19430) COMPARISON OF FILM-BADGE AND THERMOLUMINESCENT DOSIMETER FOR PERSONAL MONITORING, Yasar, Sedat (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1972. 56p. Dep. NTIS (U. S. Sales Only).

Currently, the film badge is the most widely used personnel monitoring device to measure radiation exposure. However, the use of thermoluminescent dosimeters for this purpose is now growing in popularity. The responses of film badge and thermoluminescent dosimeters (TLD-100) were compared and evaluated for personnel monitoring to the exposures of X- and gamma rays. The statistical analysis of the data indicate that at low energy exposure, X-rays of 87 keV effective energy, the slopes of the response curve are different at the 95 per cent confidence level. However, at the higher energy exposure, gamma rays of 660 keV effective energy, the slopes and intercepts were found not to differ at the same confidence level. The film badge is a more reliable and accurate system for personnel monitoring the gamma ray and X-ray exposure than the thermoluminescent dosimeter. (auth)

5329 (SC-DR-720641) OPERATIONAL TREATMENT OF MULTIPLE REFLECTION INTERFERENCE IN THE READOUT OF THIN-FILM POLY(HALO)STYRENE DOSIMETERS. Bishop, W. P.; Benson, J. L. (Sandia Labs., Albuquerque, N. Mex.). Oct 1972. 15p. Dep. NTIS.

One problem encountered in the routine usage of the Sandia doped poly(halo)styrene thin-film dosimeters is an uncertainty in the measured optical density caused by periodic constructive and destructive interference from multiple reflections at the air/plastic interfaces. Because the amplitude and period of the interference (as a function of wavelength) depend on the surface conditions and strongly on the thickness, a point-by-point subtraction of a background is not possible. In this paper we discuss the derivation of the phenomenon, when both reflections and absorptions are active in the film, and the methods by which the problem is to be handled in the routine use of the films. (auth)

5330 EMISSION SPECTRUM OF LiF (TLD-100) AT LOW AND HIGH EXPOSURES. DeWerd, L. A.; Stoebe, T. G. (Univ. of Washington, Seattle). Phys. Med. Biol.; 17: No. 2, 187-92 (Mar 1972).

The emission spectrum of LiF (TLD-100) was studied for high and low x-ray exposures. The ratio of the thermoluminescence of the high exposure (3.4×10^4R) to that of the low exposure (100 R) was the same for all wavelengths. A tendency for the emission spectrum to shift to shorter wavelengths with higher temperature glow peaks was observed. The results were consistent with those of most other investigators. (auth)

5331 DESIGN OF A THIMBLE CHAMBER FOR THE FARMER DOSEMETER. Aird, E. G. A.; Farmer, F. T. (Newcastle General Hospital, Newcastle-upon-Tyne, Eng.). Phys. Med. Biol.; 17: No. 2, 169-74(Mar 1972).

By substituting pure graphite and pure aluminium for the present chamber materials a response curve was achieved which was flat over the therapy range and constant from one instrument to another. The response depended critically on dimensions of the inner electrode and this dependence was studied and illustrated. The insulator (amber) was replaced by polytrichloro-fluoroethylene (PTCFE) which has a low induced conductivity under radiation and is chemically pure; it was necessary, however, to reduce the area exposed to the air volume on account of its higher atomic number. This reduction also improved precision of the instrument. Dimensions of the final chamber, which was identical externally to the original chamber, are given. (auth)

5332 FILM DOSIMETRY OF BETATRON ELECTRON BEAMS FOR RADIOTHERAPY PLANNING. Hayami, A.; Mori, Y.; Azuma, I.; (and others) (Osaka Univ.). Strahlentherapie; 144: No. 1, 22-8(Jul 1972).

Practical aspects of film dosimetry of high energy betatron electrons are discussed. The energy and angular dependence of the film are studied. (W.D.K.)

5333 PROTON DOSIMETER DEVELOPMENT FOR DISTRIBUTED BODY ORGANS. Khandelwal, G. S. (Old Dominion Univ., Norfolk, Va.); Wilson, J. W. Trans. Amer. Nucl. Soc.; 15: No. 2, 983-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5334 CALCULATED RESPONSE OF THE TLND PERSONNEL DOSIMETER TO NEUTRONS WITH ENERGIES ≤400 MeV. Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 984-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5335 SPECTROMETER OF GAMMA-IRRADIATION OF MAN (SICh 5.1). Belle, Yu. S.; Kovtun, A. N.; Lebedev, O. V.; Ratmanskii, B. A. (Inst. of Biological and Medical Chemistry, Moscow). Med. Radiol.; 17: No. 10, 63-7(Oct 1972). (In Russian).

A description and the main parameters of the scintillation spectrometer used for determination of gamma-radiation in man are given. A brief description of the techniques for measuring the content of radioactive isotopes unevenly distributed in the human organism is also given. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 5732 and 6497.

5336 (ANL/HFEF-2) PRECISION GAMMA SCANNER. Rizzie, J. W.; Just, F. H.; Adkins, H. E.; Adam, M. F.; Bono, R. W.; Walker, K. L.; Huebner, M. F. (Argonne National Lab., Idaho Falls, Idaho). Jul 1972. Contract W-31-109-eng-38. 168p. Dep. NTIS.

A precision gamma scanner (PGS) is used in the air cell of Hot Fuel Examination Facility/South at the EBR-II site to support the LMFBR irradiation programs. The PGS consists of an in-cell element-positioning stage, a variable-slit collimator, and a germanium-lithium gamma-detector system. Gamma scanning is supervised by a Datacraft 6024/3 computer, which operates the PGS on a 24-hr basis without operator attention. Full automation of the PGS functions has made it possible to collect vast amounts of data that could not be collected manually. No multichannel analyzer is used in the system; instead, the nuclear analog-to-digital converter and other instruments are interfaced directly to the computer through the CAMAC standard. The PGS has not only fulfilled the normal uses of a gamma scanner, such an measurements of dimensions, flux profiles, and isotope migrations, but has proven to be a sensitive device for the detection of microscopic cladding failures in irradiated fuel elements or capsules. The technique is based on identification of fission products such as ^{133}Xe, $^{140}Ba/La$, or ^{137}Cs in abnormal quantities and locations in an element or capsule. The flexibility of the in-cell positioning stage and computer-control system has made it possible to scan a variety of subjects without making hardware changes to the equipment. Operation of the PGS has shown that a computer can safely and efficiently control hot-cell examinations. (auth)

5337 (CONF-720559-2) VERY LOW NOISE AMPLIFIERS FOR SEMICONDUCTOR X-RAY DETECTORS. Eberhardt, J. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). [1972]. 7p. Dep. NTIS (U. S. Sales Only).

From Electronic instrumentation conference; Hobart, Australia (17 May 1972).

Semiconductor diodes may be used for the energy-intensity spectral analysis of X-rays which produce pulses of photoionization current in the diode. Typical diodes are of silicon 50 mm^2 in area, 4 mm in depletion layer thickness, have a capacitance of about 1 pF and have a leakage current of less than 10^{-14} A when operated at 80 K with 1000 V reverse bias. The diodes output impedance is greater than 10^{15} Ω. Typical signals are current pulses of less than 3×10^{-16} coulomb (≈2000 electron-hole pairs) in 10^{-8} s. To best match the characteristics of the detector diode, the preamplifier uses a junction field effect transistor (JFET) at its input. The JFET is cooled to 130 K to improve its noise performance. Conventional preamplifiers use commercial JFETs and glass enclosed multi kilomegohm feedback resistors both of which must be carefully selected for low noise generation. The noisy feedback resistor may be eliminated by the use of the recent techniques of charge pumping or pulsed optical feedback. The JFET dice is removed from its commercial packaging and remounted on boron nitride, a low loss dielectric for reproducible low noise performance. The preamplifier integrates the input signals and leakage current and when the accumulated charge is about 2×10^{-13} Coulomb it is removed in 4 μs by optical enhancement of the JFET's drain-gate leakage current. Careful mechanical design reduces the microphonic noise. Without very rigid mounts and electrostatic shielding of the preamplifier input connection, vibrations of only one micron would significantly increase the system noise. When suitable band pass

filtering amplifiers are used with pulsed optical feedback preamplifiers the system noise is typically 22 rms electrons (3.6×10^{-18} Coulombs rms) and may be as low as 9 rms electrons. (auth)

5338 (FRNC-TH-268) AUTOMATIC CONTROL AND RECORDING SYSTEM FOR AN IRONFREE $\pi\sqrt{2}$ MAGNETIC SPECTROMETER. Bertrand, G. (Grenoble Univ., (France)). 1972. 129p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

During modifications to the power supply of the $\pi\sqrt{2}$ ironfree magnetic spectrometer of the Grenoble Nuclear Science Institute, it was decided to automate the control system. The existing power supply was replaced by a Hewlett Packard 6181 power supply, whose voltage is supplied by a 5501 Sercel standard. The basic automation unit is a PDP 8E computer. The interface and counters are described. The program developed enables the current to be programmed; the counters to be read, reset to zero, and set into action; the carrying out of certain calculations; the presentation of the results on a teletype unit and punched tape. It was demonstrated that an accuracy of 10^{-3} is obtained with an effective stability of 2×10^{-4} with this unit. The preliminary results obtained on a study of multipolarities in the $^{129m}Te \rightarrow {}^{129}Te \rightarrow {}^{129}I$ decay chain are presented. (France)

5339 (Y-1854) AUTOMATIC DATA ACQUISITION USING A DESK CALCULATOR. Futrell, T. L. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 17 Nov 1972. Contract W-7405-eng-26. 15p. Dep. NTIS.

A system has been designed that permits automatic data acquisition and processing using a programmable electronic desk calculator. By using a calculator which is not promoted for its interfacing capabilities, but which has provisions for remote entry of data, a relatively simple, inexpensive system has been fabricated. The unit is now in production use on an X-ray spectrometer which has been updated with solid-state nuclear instrument module system counting equipment. (auth)

5340 GAMMA BAND-FILTER SPECTROMETER. Geinoz, D.; Kern, J. (Univ., Fribourg, Switzerland). Nucl. Instrum. Methods; 105: No. 1, 5-11(1972).

With a source a few mm broad placed inside the focal circle, a curved crystal spectrometer is shown to act like a gamma band-filter: only a selected band of the γ spectrum falls on and is registered by the detector, which is a coaxial Ge(Li) diode. The performance of this apparatus compares favorably with that of an anti-Compton spectrometer, as is illustrated by a study of the $^{176}Lu(n,\gamma)$ reaction. Further improvements are possible. (7 figures, 1 table) (auth)

5341 COMPUTER TREATMENT OF GAMMA SPECTRA MEASURED WITH SEMICONDUCTOR DETECTORS. Junod, E. (CEN, Grenoble, France). Nucl. Instrum. Methods; 105: No. 1, 13-22(1972). (In French).

The complexity of gamma spectra measured with semiconductor detectors made it necessary to study general and automatic computer treatments. The program described here has the following original features: searching for single and multiple peaks in unknown spectra; grouping those peaks which have a common continuum; allowing for corrections in the pseudo-Gaussian form of the peaks; finding interferences in the vicinity of a given peak; and handling series of spectra which have only similar compositions. (10 figures) (auth)

5342 REMOTELY CONTROLLED TIME-DIVIDING SPECTRUM STABILIZATION. Kawarasaki, Y. (Japan Atomic Energy Research Inst., Tokai). Nucl. Instrum. Methods; 105: No. 1, 37-44(1972).

A method and system which provide remotely controlled time-dividing gamma-ray spectrum stabilization was developed. The main feature of this system is to divide the function into time-independent modes, viz. data accumulation and gain control. The correspondence in modes of the detector and analyzer parts, which are located far apart from each other, is obtained by means of digitized and encoded control signals between them. The electronic circuits (except an analyzer and a stabilizer) are made in NIM modules, and they can be used in different combinations for various purposes. (7 figures) (auth)

5343 MONTE CARLO CALCULATION OF EFFICIENCIES AND RESPONSE FUNCTIONS OF NaI(Tl) CRYSTALS FOR THICK DISK GAMMA-RAY SOURCES AND ITS APPLICATION TO Ge(Li) DETECTORS. Nakamura, T. (Kyoto Univ.). Nucl. Instrum. Methods; 105: No. 1, 77-89(1972).

The response function, the photofraction, the total and peak efficiencies of NaI(Tl) crystals for gamma rays from thick disk sources placed on the axis of the crystal were calculated by the Monte Carlo method. The response spectra calculated by the REFUM code were compared with the measured pulse height distributions for copper, iron, magnesium, and indium disk photon sources. The agreement between the calculation and the experiment was quite good. In addition, the dependence of these quantities on the disk thickness was investigated for indium, iron, and aluminum disk photon sources. The REFUM code was applied to the calculation of the response function of Ge(Li) detectors for point isotropic ^{60}Co and ^{137}Cs gamma-ray sources. The calculated values were in pretty good agreement with the experimental values, in spite of some rough approximations. (15 figures, 2 tables) (auth)

5344 UTILIZATION OF THE HOOGENBOOM METHOD FOR ANGULAR CORRELATION MEASUREMENTS WITH Ge(Li) DETECTORS. DETERMINATION OF THE GEOMETRICAL CORRECTION COEFFICIENTS. Cailliau, M.; de Bettencourt, M. J.; Foucher, R. (Institut de Physique Nucleaire, Orsay, France). Nucl. Instrum. Methods; 105: No. 1, 141-5(1972). (In French).

The sum-coincidence method with coaxial Ge(Li) detectors is used for angular correlation measurements and applied to ^{169}Yb. Calculated geometrical correction factors are also compared with experimental results in the energy ranges 100 to 200 keV and 500 to 600 keV. (3 figures, 3 tables) (auth)

5345 PRECISION ENERGY MEASUREMENTS OF HIGH ENERGY GAMMA RAYS OCCURRING IN THE DECAYS OF ^{46}Sc, ^{82}Br, ^{99}Mo, AND ^{110m}Ag. Gardulski, P. L.; Wiedenbeck, M. L. (Univ. of Michigan, Ann Arbor). Nucl. Instrum. Methods; 105: No. 1, 169-70(1972).

Curved-crystal spectrometers were utilized to determine the energies of 21 gamma rays following the decays of $^{46}Sc(T_{\frac{1}{2}} = 83.8$ d), $^{82}Br(T_{\frac{1}{2}} = 35.4$ h), $^{99}Mo(T_{\frac{1}{2}} = 66.6$ h), and $^{110m}Ag(T_{\frac{1}{2}} = 25.3$ d). Seventeen of these gamma rays have energies in the range between 550 keV and 1121 keV, and thus provide a number of calibration standards which supplement the earlier standards published by Raeside and others. (1 table) (auth)

5346 ACTIVE SAMPLE ANTICOINCIDENCE GUARDED Ge(Li) SPECTROMETER FOR ENVIRONMENTAL RADIONUCLIDE ANALYSIS. Markwell, F. R.; Bolch, W. E.; Roessler, C. E.; Ellis, W. H. (Univ. Florida, Gainesville). Trans. Amer. Nucl. Soc.; 15: No. 2, 639(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5347 HIGH COUNTING RATE GAMMA SPECTROSCOPY SYSTEM. Gozani, T. (Gulf Radiation Tech., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 951-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5348 DISCRETE ORDINATES CALCULATION OF MULTISPHERE SPECTROMETER RESPONSE MATRIX. Sanna, R. S. (Atomic Energy Commission, New York). Trans. Amer. Nucl. Soc.; 15: No. 2, 981(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5349 CONVERSION ELECTRON SPECTRA. A LINE SHAPE ANALYSIS FOR PERMANENT MAGNET SPECTROGRAPHS. Diethrich, C.; Wiedenbeck, M. L. (Univ. of Michigan, Ann Arbor). Nucl. Instrum. Methods; 104: No. 3, 455-9(1972).

A computer analysis of the line shapes for semi-circular magnetic spectrographs has been carried out for a wide variety of parameters. New information on the optimum positioning of the photographic plate for given source and slit configurations has been obtained. The utility of a wide source, narrow slit configuration is pointed out. (auth)

5350 PROTON BEAM POSITIONING SYSTEM WITH COMPUTER CONTROL. Peterson, D. G. (Univ. of Manitoba, Winnipeg). Nucl. Instrum. Methods; 104: No. 3, 451-4(1972).

A computer-controlled system designed to stabilize the lateral position of a beam of protons is described. Two scintillation counters, located close to the horizontal waist of a proton beam, sampled about 0.1% of each side of the beam. Their counts were recorded 50 to 100 times per second by a PDP-15 computer and compared. If the asymmetry in the counts was outside software-specified limits, the computer corrected for the drift in beam position by adjusting the current in a steering magnet situated 3 m upstream of the scintillation counters. If the net correction became very large, a warning was given. This system is used in the wire chamber spectrometer at the Manitoba cyclotron to control the horizontal position of a 42 MeV proton ribbon beam 2 mm wide and 50 mm high having an intensity up to 5 nA. Tests have shown that the lateral position of the beam centroid can be maintained within ± 0.1 mm, provided that the lateral beam profile does not change appreciably with time. (auth)

5351 TWO-COMPUTER SYSTEM USED ON-LINE TO A WIRE CHAMBER SPECTROMETER: DESCRIPTION AND OPERATIONAL EXPERIENCE. Greeniaus, L. G.; Jovanovich, J. V.;

McKeown, J.; Reimer, D.; Thompson, J. C. (Univ. of Manitoba, Winnipeg). Nucl. Instrum. Methods; 104: No. 3, 437-46(1972).

An inexpensive and efficient system allowing fast conversation between two computers and complete on-line analysis of data from a wire chamber spectrometer is described, and operational experience in using this system in physics experiments is reviewed. Wire chambers and scintillation counters are interfaced to a DEC PDP-15 computer which is connected to an IBM 360/65 via a high speed data-link. The PDP-15, programmed in an assembler language, controls equipment, performs preliminary analyses, rejects bad events and sends good candidates to the IBM 360/65. A FORTRAN program residing in a small portion of the 360/65 memory completes kinematic analyses of events accepted by the PDP-15, stores the result on magnetic tape, and returns control words and histograms to the PDP-15. (auth)

5352 FERRITE CORE READ OUT WITH SOFTWARE DECODING. McKeown, J. (Univ. of Manitoba, Winnipeg). Nucl. Instrum. Methods; 104: No. 3, 433-5(1972).

A simple ferrite core read-out system used for some time in the Manitoba Cyclotron wire chamber spectrometer is described. The spark information from the cores is transferred directly into the computer memory and then decoded by the computer itself. The advantage of this system is its low cost, simplicity and flexibility, although it is in general too slow to use in large wire chamber systems where fast read-out is important. (auth)

5353 THEORETICAL ANALYSIS OF A TIME-OF-FLIGHT MASS SPECTROMETER WITH SPHERICAL ELECTRODES AND RADIAL ION PATHS. Zabielski, M. F.; Stein, R.; Kendall, B. R. F. (Pennsylvania State Univ., University Park). J. Mass Spectrom. Ion Phys.; 10: No. 2, 109-22(Dec 1972).

A general expression for the total ion flight time is derived for a time-of-flight mass spectrometer having four concentric spherical electrodes which bound two accelerating regions and a drift region. The special case of negligible initial velocity is then considered, and it is shown that the spherical geometry gives space-time focusing characteristics which are at least as good as those of instruments having similarly space cylindrical or planar electrodes. The use of spherical electrodes also offers a large entrance area into which ions can be drawn from a surrounding plasma, provides equal sensitivity for ions entering from all directions, and allows the use of a very small ion collector such as a channel electron multiplier. It follows that this type of mass spectrometer may be a particularly attractive choice for applications requiring unusually high sensitivity. (auth)

5354 ION DETECTION IN MASS SPECTROMETRY: THE DEPENDENCE OF ION-SENSITIVE PLATE RESPONSE ON ION STRUCTURE AND COMPOSITION. Vouros, P.; Desiderio, D. M.; Leferink, J. G.; Odiorne, T. J.; McCloskey, J. A. (Baylor Coll., Houston, Tex.). J. Mass Spectrom. Ion Phys.; 10: No. 2, 133-42(Dec 1972).

The response of various types of ion-sensitive plates as a function of ion structure and composition has been investigated. Several ions of similar nominal mass and equal energy covering a wide variation in structure have been studied. It has been found that the response of the emulsion is dependent on the structure and composition of the impinging ion. The selectivity of emulsion response to molecular ions of variant structure is discussed in terms of a mathematical model proposed by Honig. The experimental results suggest that monoatomic ions and ions generally containing a smaller number of atoms produce darker photographic images than ions of the same mass and energy, but of more polyatomic nature. Ions of similar structure produce images of equal relative intensity but a dependence on chemical composition is also apparent. The evaporated silver bromide plates exhibited a linear relationship of total peak area versus log relative exposure over a dynamic range of at least 100. (auth)

5355 USE OF WIRE CHAMBERS IN IMPROVING ENERGY RESOLUTION OF LARGE SCINTILLATION COUNTERS. Millar, T. W.; Jovanovich, J. V. (Univ. of Manitoba, Winnipeg). Nucl. Instrum. Methods; 104: No. 3, 447-50(1972).

Relatively large scintillation counters were constructed as a part of a wire chamber spectrometer to measure proton energies in the range between 7 MeV and 50 MeV. In these counters, the pulse heights were dependent on the positions at which the protons entered the detectors, resulting in a deterioration of the overall energy resolution. Using position information from wire chambers placed in front of the scintillators, it was possible to correct for this non-uniformity and improve the resolution, making it comparable to that for protons hitting small areas at the center of the counters. (auth)

5356 QUASI-ELASTIC SCATTERING FROM A TOF CRYSTAL ANALYZER. Watanabe, N. (Tohoku Univ., Sendai); Niimura, N.; Oyamada, M.; Kimura, M.; Sato, K. Kakuriken Kenkyu Hokoku; 4: No. 2, 81-8(Feb 1972). (In Japanese).

A spectrometer which can measure the quasi elastic scattering by detecting a particular scattered neutron with a single crystal was designed and constructed. This spectrometer has various characteristic features in comparison with the usual monochrometer. A schematic diagram of the spectrometer is given. The flight path of the incident neutron was 391 cm long. The scattering angle to be measured was set at 20°, 50°, 95°, 120° and 150°. The incident neutron was a white energy neutron obtained from a 300 MeV electron linear accelerator of Tohoku University. The resolving power was about 0.1 MeV at 002, and the maximum resolving power will be 0.05 MeV. Measurements of the quasielastic scattering due to the self diffusion of hydrogen atoms in vanadium hydride of α phase were performed since this spectrometer was useful in a region of large momentum. Observed spectra are shown in figures. A line broadening due to the diffusion of hydrogen atoms was definitely observed in measuring $VH_{0.42}$. The peak of 002 was not observed as well as in the case of pure vanadium. The value of $\Delta\omega$ at $Q^2 = 2.59$ Å^{-2} was in agreement with the value of 1.35×10^{-12} sec^{-1} by Rowe et al. Measurements for various ratios of components are in progress. (Japan)

5357 TWO-ARM WIRE CHAMBER SPECTROMETER FOR USE AT 30 TO 50 MeV INCIDENT PROTON ENERGIES. McKeown, J.; Greeniaus, L. G.; Jovanovich, J. V.; (and others) (Univ. of Manitoba, Winnipeg). Nucl. Instrum. Methods; 104: No. 3, 413-31(1972).

A wire chamber spectrometer connected on-line to two computers has been developed to study reactions having two (or more) charged particles in final states at incident proton energies in the range 30–50 MeV. It consists of two wire chamber and scintillation counter hodoscopes capable of detecting protons with kinetic energies between 7 MeV and 50 MeV. The two computers are used for complete reduction of data on-line. The spectrometer has been used so far in measuring cross sections for p–p bremsstrahlung and some (p,2p) reactions. (auth)

High Energy Physics Instrumentation

Refer also to abstract 5820.

5358 (LNF-72/59) TOROIDAL MAGNETIC FIELD SPECTROMETER FOR EXPERIMENTATION WITH HIGH-ENERGY BEAMS. Spillantini, P. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 19 Jun 1972. 4p. (CONF-720951–1). Dep. NTIS (U. S. Sales Only).

From ECFA study week on the 300 GeV accelerator conference; Tirrenia, Italy (20 Sep 1972).

Topics briefly discussed include the general characteristics for high energy reactions, toroidal magnetic field, and spectrometers with toroidal magnets. The main parameters for a general setup to be used for particles up to 200 GeV/c are given. (W.H.K.)

5359 (SLAC–151) USE OF A MACRO PROCESSOR WITH SUMX. Park, J. C. H. (Stanford Linear Accelerator Center, Calif.). Jun 1972. Contract AT(04-3)-515. 26p. Dep. NTIS.

A scheme for equipping SUMX with a macro facility which consists of making one preprocessing pass through a general purpose macro processor called MACROS is described. MACROS is written in PL/I and CHARMS (calculating routine) and SUMX are in FORTRAN IV and are running on an IBM 360/91. The scheme is described by data for a three prong bubble chamber event. (W.H.K.)

5360 APOCHROMATIC METHOD FOR MEASURING THE MEAN 657 MeV PROTON ENERGY BY USING VAVILOV–CHERENKOV RADIATION. Zrelov, V. P.; Pavlovic, P.; Sulek, P. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods; 105: No. 1, 109-16(1972).

An apochromatic method for measuring the mean charged-particle energy by means of Vavilov–Cherenkov radiation when a couple of plane prism doublets is used is described in detail. The results of checking this method by using the 657-MeV proton beam extracted from the Dubna synchrocyclotron are presented. The error of the mean energy determination is ±0.27 MeV. (8 figures, 4 tables) (auth)

5361 STREAMER CHAMBER FILLED WITH ^{3}He. Falomkin, I. V. (Joinst Inst. for Nuclear Research, Dubna, USSR); Korolyov, V. P.; Kulyukin, M. M.; (and others). Lett. Nuovo Cim.; 5: No. 11, 757-60(11 Nov 1972).

A description is given of the design, operation and performance of a ^{3}He-filled streamer chamber used to study elastic and inelastic scattering of pions on helium-3 at 100 to 200 MeV. (L.B.S.)

5362 GEOMETRIC FACTOR OF A COSMIC RAY DETECTOR: EQUIVALENCE OF ALTERNATIVE ANALYTICAL DERIVATIONS. Willis, D. M.; Thomas, G. R. ELDO/ESRO Sci. Tech. Rev.; 4: No. 2, 101-2(1972).

The geometric factor of a cosmic ray detector defined by two unequal circular or rectangular areas is derived analytically for both isotropic and $\cos^2$ theta variations of incident particle intensity. It is demonstrated mathematically that an approach based on shadow areas yields results identical with those obtained previously using an approach based on the direct integration of infinitesimal areas. (France)

Radiometric Instruments

Refer also to abstracts 5434, 5692, 5693, and 6788.

5363 X-RAY MONITOR FOR MEASUREMENT OF TITANIUM TRITIDE TARGET THICKNESS. Alger, D. L.; Steinberg, R. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 15: No. 2, 711-12(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5364 COMPARISON OF RADIATIVE CAPTURE WITH DECAY GAMMA-RAY METHOD IN BORE HOLE LOGGING FOR ECONOMIC MINERALS. Senftle, F. E.; Moxham, R. M.; Tanner, A. B. (Geological Survey, Washington, DC). Nucl. Instrum. Methods; 104: No. 3, 485-92(1972).

The recent availability of borehole logging sondes employing a source of neutrons and a Ge(Li) detector opens up the possibility of analyzing either decay or capture gamma rays. The most efficient method for a given element can be predicted by calculating the decay-to-capture count ratio for the most prominent peaks in the respective spectra. From a practical point of view such a calculation must be slanted toward short irradiation and count times at each station in a borehole. A simplified method of computation is shown, and the decay-to-capture count ratio has been calculated and tabulated for the optimum value in the decay mode irrespective of the irradiation time, and also for a ten minute irradiation time. Based on analysis of a single peak in each spectrum, the results indicate the preferred technique and the best decay or capture peak to observe for those elements of economic interest. (auth)

5365 FUNDAMENTAL STUDIES ON RADIATION THICKNESS GAGE. VII. BLUR OF SHADOW WITH SCATTERED RAYS. (VII). Koyanagi, Takami; Aida, Kazuo (Niigata Univ., Nagoaka, Japan). Radioisotopes (Tokyo); 21: No. 10, 597-602 (Oct 1972). (In Japanese).

5366 LIQUID LEVEL MEASURING. Bagge, E.; Truemper, J. (to VDO Tachometer Werke Adolf Schindling GmbH). British Patent 1,288,263. 6 Sep 1972. Filed 25 Feb 1969.

Reference is made to the measurement of liquid levels by radiation means. The apparatus used is in the form of a probe consisting of a neutron detector, with neutron sources distributed along the length of the probe. The detector is a neutron counting tube of commercially available type. If the neutron sources are uniformly distributed along the length of the probe there will be a linear relationship between the depth of immersion of the probe in the liquid and the counting rate of the detector, and in the case of tanks of constant cross section the indication of liquid level will be linear. With tanks of irregular shape it is possible to obtain a linear measuring characteristic by distributing the neutron sources in a suitably non-uniform manner along the length of the probe, and it is possible to obtain an accurate indication of the presence of small residual quantities of liquid. A warning device may be provided to indicate the presence of such liquid. Various uses are described. (UK)

5367 ELECTRON MICROSCOPY 1972. Proceedings of the Fifth European Congress, Manchester, England, September 5–12, 1972. London; Institute of Physics (1972). 684p. £ 15. (CONF-720913).

Two-hundred seventy-five papers were presented under the following sections: Electron sources; complete microscope systems; theoretical electron optics; lens design and construction; analytical electron microscopy; detectors and displays; electron diffraction and energy analysis; biological specimen preparation techniques; cryo-techniques; cytochemical methods; ion thinning and electrolytic and chemical methods; specimen stages; in situ experiments; in situ experiments in the scanning electron microscope; general theory of image formation; scattering processes; scanning electron microscope contrast effects; transmission electron microscope contrast effects; energy loss and radiation effects; optical diffraction and filtering; three-dimensional reconstruction; recording, processing and correction of images; obtaining maximum resolution and information; and special techniques. Separate abstracts have been prepared for 21 of these papers. (UK)

For abstracts of individual papers see: 5368–5375, 5405, 5610, 5691–5693, 5793, 5794, 6401, 6788, and 6812–6815.

5368 SUPERCONDUCTING LENSES. Septier, A. (Paris Univ., Orsay, France). pp 104-9 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From fifth European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

A section on the properties of superconducting materials is followed by a description of superconducting lenses under the following headings: Lenses with SC windings (ironless lenses; shielded coils); lenses with classical ferromagnetic pole pieces; utilization of the shielding or trapping properties of hard superconductor rings (SC magnetic shielding; superconducting rings and disks); special problems concerning SC lenses (lens excitation and focal distance fine adjustment; symmetry of the field); lens cryostats; and advantages of SC lenses. (UK)

5369 MEASUREMENT OF THE MAGNETIC FIELD IN ELECTRON-OPTICAL LENSES. Verster, J. L.; Kiewiet, T. W. (Univ., Groningen, Netherlands). pp 110-11 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From fifth European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

Details are given of a method in which the magnetic induction along the axis of the lens is measured by means of a cylindrical search coil moved along the axis. Ancillary equipment includes a low-drift galvanometer amplifier, an integrating operational amplifier, with input resistor and feedback capacitor, and a two-pen recorder. Construction of the search coil is described. The lens is mounted in a He evaporation cryostat and is energized by a superconducting coil kept at about 7°K, which is low enough to keep the coil superconductive at 20 A. (UK)

5370 PROPERTIES AND APPLICATIONS OF A SUPERCONDUCTOR OBJECTIVE FOR A 300 kV MICROSCOPE. Trinquier, J.; Balladore, J. L.; Martinez, J. P. (CNRS, Toulouse). pp 118-19 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From fifth European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

Performances of a superconducting objective mounted on a 300-kV high-tension electron microscope are described, together with some applications. The lens employed could equally well be used at 1000 kV. Details are given of the construction. (UK)

5371 REVIEW: SPUTTER THINNING FOR TRANSMISSION ELECTRON MICROSCOPY. Barber, D. J. (Univ. of Essex, Eng.). pp 293-5 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From fifth European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

Sputter thinning is successfully used for the preparation of foils for transmission electron microscopy as well as in other fields. Improvements in the technique are, however, desirable, particularly in regard to surface topography and minimizing surface roughness and radiation damage. Improved machines will also become available with the development of new ion sources and chamber configurations. Some of the more promising developments are discussed. (17 references) (UK)

5372 ION BEAM THINNING OF CYLINDRICAL OBJECTS. Goodhew, P. J.; Hepburn, M. J. (Univ. of Surrey, Guildford, Eng.). pp 300-1 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From fifth European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

Methods such as mechanical or chemical polishing or cleavage normally used for the preparation of nonconducting specimens for transmission electron microscopy are not suitable for preparing foils from fine cylindrical specimens, such as glass or carbon fibers, whilst preserving a knowledge of the fiber axis, but ion-beam machining offers a good prospect of overcoming these difficulties. A study is described of the thinning of individual carbon and glass fibers in this way. A 50-μA beam current per gun at 5 kV was employed, and early results with carbon fibers showed that the method was successful in giving extensive electron-transparent areas along one or both sides of every fiber. When thinning was continued until the fiber had almost disappeared, the whole width of the remaining material was thin enough for examination at 100 kV. All the micrographs showed a striated structure along the fiber axis. Three types of ions (Ar, O, N) were used to investigate whether there was any variation of structure with ion weight and chemical activity. Observations of the fibers by scanning electron microscopy at various stages during the thinning showed clearly how the longitudinal structure originally present was sputtered away and replaced by transverse striations. Glass fibers thinned under identical conditions appeared not to develop a striated structure. A further feature was that a fiber does not thin uniformly, but develops facets at a

particular angle to the ion beam, despite rotation of the specimen. (UK)

5373 ELASTIC AND INELASTIC SCATTERING. Whelan, M. J. (Oxford Univ.). pp 430-5 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From fifth European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

The following topics are discussed: elastic and inelastic scattering of single atoms; contrast from single atoms imaged with the electron microscope; and elastic and inelastic scattering by crystals. (UK)

5374 BEAM-INDUCED RADIATION DAMAGE IN POLYMERS AND ITS EFFECT ON THE IMAGE FORMED ON THE ELECTRON MICROSCOPE. Grubb, D. T.; Keller, A. (Univ. of Bristol, Eng.). pp 554-60 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From fifth European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

A brief account is given of the effects of electron irradiation on organic materials in the electron microscope. Elastic interactions produce image contrast but no damage, whereas inelastic interactions can produce permanent changes. Particular reference is made to polymers. Doses in the electron microscope are considered, including the effects of heating by the beam. Amongst other matters considered are the effects on diffraction patterns and diffraction contrast and the origin of image contrast in non-diffracting specimens. Photomicrographs are shown for polyethylene. (UK)

5375 EFFECT OF COOLING ON THE DIFFRACTION PATTERN OF BEAM-SENSITIVE SPECIMENS. Dobb, M. G. (Univ. of Leeds, Eng.). pp 564-5 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From fifth European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

Several methods for minimizing specimen damage in the electron microscope have been considered, including the use of high accelerating potentials, low illumination intensities, and specimen cooling. Some quantitative data have already been published regarding the first two of these, but very little information is available regarding the effects of specimen cooling. Preliminary results are presented for some cellulose fibrils; it was evident that in this case cooling could promote the attainment of very high micrograph resolution. (UK)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 5317, 5785, 5815, and 6803.

5376 (CEA-R-4337) SIMULATION OF GAMMA RAY EFFECTS ON BIPOLAR TRANSISTORS USING THE CAO PROGRAMS. Cottin, P.; Hantelle, G. (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Jul 1972. 29p. (In French). Dep. NTIS (U. S. Sales Only).

It is demonstrated how the primary and secondary photocurrents of bipolar transistors exposed to pulsed γ radiation can be calculated using the LINVILL model with the addition of two-dimensional elements of the IBIS model. This idea was developed by the CEA. (France)

5377 FAST-NEUTRON DAMAGE IN Ge(Li) DETECTORS. Graf, J. M.; Johnson, W. R. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 15: No. 2, 710-11(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Miscellaneous Instruments

Refer also to abstracts 4946, 6446, 6917, 7168, and 7205.

5378 (CEA-CONF-1897) SOME DEVELOPMENT IN FAST ELECTRONICS IN SIGNAL PROCESSING. Mey, Jacques (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 12 Apr 1972. 11p. (In French). (CONF-720452-5). Dep. NTIS (U. S. Sales Only).

From Half-day conference on the treatment of the ultrafast transient signal; Saclay, France (12 Apr 1972).

Three recent developments in fast electronics in signal processing are briefly described. These are a numerical analyzer of signals with minimum rise time of 2 nsec, a chronometer with a precision better than 10^{-4} for time intervals of 100 μsec and ±300 psec for short intervals less than 1 μsec, and a real fast time multicorrelator. (J.S.R.)

5379 (CEA-R-4340) AN INEXPENSIVE ANALOGUE-NUMERICAL CONVERTER. Goursky, Vsevolod (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jul 1972. 17p. (In French). Dep. NTIS (U. S. Sales Only).

An inexpensive analogue-numerical converter intended for nuclear applications is described. The converter operates in accordance with the WILKINSON principle with a clock frequency of 20 MHz and a maximum of 512 channels. The compact electronics enables it to be fitted, easily, into a standard CAMAC unit. The main specifications are as follows: integral nonlinearity: $\pm 1.5 \cdot 10^{-4}$; differential nonlinearity: ±0.5 per cent; instability of the threshold zero channel: <0.25 mV/°C; instability of the conversion gain: $<10^{-4}$/°C. (auth)

5380 (HEDL-TME-72-117) PERFORMANCE TESTS OF AN MgO INSULATED COAXIAL CABLE FOR REACTOR INSTRUMENTATION APPLICATION. Philipp, L. D.; Schemmel, R. R.; Spear, W. G. (Hanford Engineering Development Lab., Richland, Wash.). 23 Aug 1972. Contract AT(45-1)-2170. 50p. Dep. NTIS.

An experimental cable has been tested according to RDT Standard F 3-39-T. The effects of time, temperature, and polarization on breakdown pulse noise (BPN) were determined to be minor compared to the effects of unsatisfactory end seals (frit glass). The cable provided satisfactory operation up to 1000°F and 400 Vdc. (auth)

5381 (IPP-9/6) VERY BRIGHT FIELD IONIZATION AND FIELD EVAPORATION ION SOURCES. SOME USES. A BEAM FORMATION AND SCANNING SYSTEM. Heil, H.; Guckenberger, R. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Jun 1972. 18p. Dep. NTIS (U. S. Sales Only).

Field ionization and evaporation ion sources in the form of small wire tips are capable of delivering brightnesses many orders of magnitude larger than conventional sources, with the apparent source size in the 10Å range. Therefore, they serve well as small ion probes for scanning instruments. These instruments, in turn, are unique in their ability to machine very small structures by sputtering, smaller than can be made by other means. Uses are in surface micro-analysis, microelectronics, electron and X-ray diffraction and manipulation and treatment of macromolecules. For focusing, only electrostatic lenses can be used. Computations have shown the aperture lens to be far superior to the usual einzel lens with respect to smallness of focal length and spherical aberration constant. This advantage has to be weighed against the complication of having the target immersed into the electric field. The design of a scanning ion microscope which incorporates such a lens is described. (auth)

5382 (LA-5059) SPECIFICATIONS FOR CAMAC SUBROUTINES. Thomas, R. F. Jr. (Los Alamos Scientific Lab., N. Mex.). Oct 1972. Contract W-7405-eng-36. 10p. Dep. NTIS.

This report was prepared under the guidance and sponsorship of the CAMAC Software Working Group of the U. S. AEC NIM Committee. Descriptions of six FORTRAN-compatible subroutines recommended for use with CAMAC systems are presented. These subroutines permit the most general operations on a CAMAC system to be specified in a high-level programming language. Two of the subroutines implement the fundamental CAMAC functions; three of them implement the three uses of the Q response defined in TID-25875; the remaining subroutine provides a flexible alternative for CAMAC addressing. (auth)

5383 (RN-S-391) HIGH TEMPERATURE INSTRUMENT DEVELOPMENTS AT ARGONNE NATIONAL LABORATORY OF INTEREST TO THE NERVA PROGRAM. Popper, G. F.; Knox, A. E. (Argonne National Lab., Ill.). [nd]. 19p. Dep. NTIS.

The development and testing of fuel pin thermocouples and fission gas pressure transducers for the LMFBR that can be used in the NERVA program are outlined. Small-diameter thermocouples utilizing very high resistivity thoria insulation, tungsten–rhenium thermoelements, and tantalum or tungsten–rhenium sheaths that can be useful at 5530°R are described. Statham Model PA-812 thin film pressure transducers for operation at high temperature are briefly discussed. (W.H.K.)

5384 (UCRL-73967) CAMAC HIGH RESOLUTION TIME INTERVAL METER. Wiedwald, J. D. (California Univ., Livermore. Lawrence Livermore Lab.). 13 Jun 1972. 6p. (CONF-721202-2). Dep. NTIS.

From Nuclear science symposium; Miami Beach, FL. (6 Dec 1972).

A four channel Time Interval Meter (TIM) with one-quarter-nanosecond resolution was designed and packaged in a triple width CAMAC module. The TIM has a common Start and four Stop inputs with a total range of 65,536 nanoseconds plus an overflow bit, with basic accuracy dependent on an internal 125 MHz crystal controlled clock. (auth)

5385 ISOCON TV CAMERA–MAGNETIC TAPE RECORDER SYSTEM FOR THE ANALYSIS OF FAST OSCILLOSCOPE TRACES. Bosia, G.; Marangoni, G.; Maringelli, M.; Navarra, G. (CNR, Turin). Nucl. Instrum. Methods; 105: No. 1, 117-23(1972).

A system for recording and analyzing Tektronix 519 oscilloscope traces in cosmic-ray applications is described. The recordings are accomplished by an isocon TV camera and a magnetic tape recorder. During the analysis operation the TV recorder is followed by circuitry which converts the analog video information into digital words and presents them to the interface of an IBM 1130 computer connected on line with the apparatus. The accuracy on amplitude measurements of the traces is better than 100 mV; with an oscilloscope sweep rate of 5 ns/cm an accuracy on time measurements of 120 ps is obtained. (9 figures) (auth)

5386 PHOTOMULTIPLIERS OUTPUT PULSE SHAPE. Bianchetti, G.; Righini, B. (CERN, Geneva). Nucl. Instrum. Methods; 105: No. 1, 45-50(1972).

The shape of photomultiplier output pulses was studied for two operating conditions: single-electron response (SER) and the case when the photomultiplier is associated with a scintillator. An accurate measurement of the SER mean pulse shape was performed. The comparison of output pulse shapes when the PM is placed in a setup that is typical for most nuclear physics experiments showed a dependence of the pulse shape on the pulse amplitude. (5 figures) (auth)

5387 STABLE PULSED LIGHT SOURCE USING LOW-COST LIGHT-EMITTING DIODES. Thorngate, J. H.; Perdue, P. T. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 105: No. 1, 57-60(1972).

A light pulser, using low-cost gallium arsenide phosphide light-emitting diodes, was designed that offers pulses adjustable in height and length, good resolution (3% typical), and excellent stability (0.5% typical). Stability is achieved by using integrated circuits and operating the diode in a current rather than a voltage mode. (3 figures, 1 table) (auth)

5388 DEVICE FOR AUTOMATICAL RECORDING OF DELAYED COINCIDENCE CURVES. Baldin, B. J.; Cisek, Z.; Kosciuk, A.; Ronzhin, A. I.; Szawlowski, M. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods; 105: No. 1, 157-60(1972).

A device recording delayed coincidence curves with a charge storage diode as controlled delay element is described. The range of variation for the delay is equal to 100 ns. The maximum dead time equals 135 ns. The integral nonlinearity is less than 0.5%. The temperature stability is better than 1 ns/°C. (6 figures) (auth)

5389 TIMING SYSTEM FOR HIGH RESOLUTION TIME SPECTROSCOPY. Bialkowski, J.; Moszynski, M. (Inst. of Nuclear Research, Swierk, Poland). Nucl. Instrum. Methods; 105: No. 1, 51-6(1972).

A timing system working with plastic scintillation counters is described. It gives the best time resolution of 130 ps and 195 ps for 20% and 90% windows, respectively, for ^{60}Co Compton spectra, with NE 111 scintillators and XP 1021 photomultipliers. The time resolutions obtained using XP 1021 and XP 1023 photomultipliers did not show any difference. 56 DUVP photomultipliers working with 2.5 cm × 1 cm NE 111 scintillators, in spite of the twice larger time spread, gave a time resolution only 20% worse for ^{60}Co owing to higher quantum efficiency of the bialkali photocathode. It was shown that for larger scintillators, especially when NE 111 cannot be used because of light attenuation, the time resolution obtainable with 56 DUVP is better than that with XP 1021. (8 figures, 2 tables) (auth)

5390 CHARACTERISTICS OF P-CHANNEL MOS FIELD EFFECT TRANSISTORS WITH ION-IMPLANTED CHANNELS. Hswe, M.; Palmer, R. B.; Shopbell, M. L.; Mai, C. C. (Mostek Corp., Worcester, Mass.). Solid-State Electron.; 15: No. 11, 1237-43(Nov 1972).

Ion implantation technology was employed in the fabrication of MOS devices. Boron doses in the range of 0.4×10^{12} to 1.72×10^{12} ions/cm^2 were implanted into the channels of MOSFETs at 42 keV. Both low-threshold enhancement-mode and depletion-mode devices were obtained. The variation of threshold voltage of enhancement-mode devices and drain to source current of depletion-mode devices as a function of boron doses is reported. It was found that boron implantation under these conditions has no significant effect on the current gain constant k', p–n junction leakage current, or threshold stability of MOS devices. Boron-implanted MOS capacitors were also studied. The I–V plots on capacitors implanted with moderate doses exhibit parallel shifts to the positive voltage direction, due to the presence of the very shallow nonuniformly doped layer on the silicon surface. (auth)

5391 PRECISE EVALUATION OF THE 3 COMPONENTS OF A MAGNETIC FIELD BASED ON VOLTAGES INDUCED ON 3 HALL PROBES. Turck, B. (SEDAP, Saclay, France). Nucl. Instrum. Methods; 105: No. 1, 97-101(1972). (In French).

Through measurements with three perpendicular Hall probes, by using an analytic expression of the voltage including normal and planar Hall effects, it is possible to evaluate the three components of a magnetic field with a very good accuracy. (9 figures) (auth)

5392 SPECTROMONITOR: A NEW RAPID SCANNING SPECTROPHOTOMETER AND ITS APPLICATIONS. Grabowski, Z. R.; Koszewski, J.; Jasny, J. (Inst. of Physical Chemistry, Warsaw). Chem. Anal. (Warsaw); 17: No. 3, 717-26(1972).

The basic concepts of a new fast spectrophotometric analytical method and the application of it using the "Spectromonitor" are described. The electronically controlled monochromator with the flying spot scanner as a light source enables to obtain 25, 50, or 100 analyses per sec. The spectral range is 240 to 760 nm in two subranges. The spectra are recorded on the TV screen using the raster method. The examples given concern the investigation of the reaction kinetics of enzymatic and photochemical processes. (auth)

5393 MODULATED ELECTRON BEAM SPECTROMETER FOR IONIZATION CROSS-SECTION MEASUREMENTS. Grasso, F.; Lo Savio, M.; Pitrone, N. (Univ., Catania, Italy). Lett. Nuovo Cim.; 5 No. 3, 253-60(16 Sep 1972).

The spectrometer consists of an Atlas CH4 mass spectrometer equipped with pulsed Fox-type ion source and secondary-electron multiplier, a lock in amplifier with modulator, an analogic derivator, and a multichannel averager. The spectrometer operates with a modulated retarding potential to reduce noise due to electronic drifts and to reactivity of the gas in the ion source. (W.H.K.)

5394 DETERMINATION OF THE CHARACTERISTICS OF TOROIDAL ELECTROSTATIC ANALYZERS. APPLICATION TO THE OPTIMIZATION OF ANALYZERS USED IN SPACE PHYSICS. Decreau, P. (Centre National de la Recherche Scientifique, Orleans-la-Source, France); Prange, R.; Berthelier, J. J. Rev. Phys. Appl.; 7: No. 2, 95-106(Jun 1972). (In French).

A numerical method is presented for calculating the properties of electrostatic particle analyzers. The method is valid for toroidal electrodes. The electrostatic field is expressed in the form of a finite series with reduced coordinates defining the position of a point in relation to the mean equipotential. The coefficients of this expansion are evaluated up to a given order, the trajectory of a particle being determined by numerical integration of the equations of motion. The characteristics of the analyzer were determined by examining different cases of incidence. The results are compared with those obtained using an electrolytic tank. Two examples are given of the use of the numerical program developed. (France)

5395 MICROPROGRAMMABLE BRANCH DRIVER (MBD-11) (May 1972) (Engineering Materials). (Los Alamos Scientific Lab., NM). (CAPE–2228).

10 drawings.

The MBD-11, which is the interface between a Digital Equipment Corporation (DEC) PDP-11 computer and a multicrate CAMAC system, is described. The PDP-11 acquires, preprocesses, and records data; monitors the condition of experimental apparatus; executes necessary control functions; and performs preliminary analyses to forecast the results of experiments. (F.S.)

5396 NOVA CAMAC BRANCH DRIVER (12 May 1972) (Engineering Materials). (Los Alamos Scientific Lab., NM). (CAPE–2230).

11 drawings.

The BD-NOVA branch driver, which is described, is the interface between a Data General Corporation NOVA or SUPERNOVA computer I/O and a multicrate CAMAC system designed to CAMAC specifications. This driver has a command register and a data register which are loaded and read with I/O instructions. The instructions are used to load and read the command register with the NAF command and modifier bits. (F.S.)

5397 LABORATORY PROGRAMMER (9 Sep 1971) (Engineering Materials). (Brookhaven National Lab., Upton, NY). (CAPE–2247).

11 drawings.

A versatile programmer used to control the operation of low and high power circuits over a wide range of time intervals is described. Activation experiments require the operation of a

mechanical chopper, several solenoid valves, and electronic counting equipment. Once programmed, cycle times are reproducible and accurate over a time range of from 10 msec to minutes or more. (F.S.)

5398 OPTICAL DENSITOMETER (23 Feb 1972) (Engineering Materials). (Brookhaven National Lab., Upton, NY). (CAPE-2256).

3 drawings.

The densitometer is used as an aid in locating plumes, in determining plume geometries, i.e., the lateral and vertical extent of a plume at various distances downstream, information on plume rise, partical background data, and correlation of the transport and diffusion of gaseous and aerosol matter. Components include a light bulb, two sets of lenses for proper collimation, a light-tight compartment, a detecting device and a recording mechanism. It utilizes 90° light scattering from particles (0.01 to 10 μ dia) which are drawn through the detecting unit. Stability is governed by the light flux from the bulb and the stray light reflections within the chamber. Light-bulb flux variations are minimized by using a highly stable power supply as a source of energy and keeping the voltage under constant surveillance during operation. Impaction of particles in the soot used to blacken the detecting chamber shifts the stray-light zero and affects the overall calibration. When the stray-light zero can no longer be adjusted, the densitometer is taken apart, cleaned and reblackened. The densimeter is calibrated before each use. (F.S.)

5399 PLUME SAMPLING INSTRUMENTATION (Engineering Materials). (Brookhaven National Lab., Upton, NY). (CAPE-2255).

2 drawings.

Airplane onboard instrumentation, to provide a continuous record of pertinent parameters for monitoring meteorological data and plume characteristics, is described. All instrumentation is fastened to a $\frac{1}{4}$ in. by 16 in. by 30 in. Al base which is shock mounted. Total weight of the instrumentation package is 80 lbs. The meteorological, ambient-temperature, and dew-point sensors are mounted in a vortex tube attached to a port-wing strut. Pressure-altitude is monitored from the static line inside the aircraft. Intake lines for gaseous pollutant monitors are placed in the fresh air intake ducts. Monitored parameters are selected for input by the observer with the use of a variable selector system which permits any three to be recorded simultaneously. (F.S.)

5400 TEMPERATURE PROFILER (24 Jul 1972) (Engineering Materials). (Virginia Inst. of Marine Science, Gloucester Point). (CAPE-2260).

2 drawings.

This instrument employs thermistors mounted in glass probes for water sensors. The thermistors are waterproof, have a fast time constant, and are interchangeable without calibration. Stainless-steel housing for the thermistors mates with a standard under-water connector. The thermistor probe is potted into the end with silicon rubber molded under pressure for a leak proof seal. Thermistors mounted in small glass beads are used as air-temperature sensors. The electronics include a bridge circuit, power supply, a buffer amplifier and a preamplifier. The thermistors sense temperature with an accuracy of 0.1°C. The Temperature Profiler is one of the instruments used to make environmental measurement from a boat to measure the heat discharged into the James River estuary by the Surry nuclear power plant located on Hog Island in Virginia. (F.S.)

5401 NUCLEAR INSTRUMENT LANDING SYSTEM. Kaminskas, R. A. (TRW Systems Group, Redondo Beach, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 699-700(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5402 DIGITAL PHOTOMETER FOR STUDIES OF SPECTRA PRODUCED BY IONIZING RADIATION. Thiess, P. E.; Visel, T. A.; Kwitkowski, P. A. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 15: No. 2, 707-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5403 HIGH-TEMPERATURE ULTRASONIC THERMOMETER FOR IN-REACTOR FUEL ROD CENTERLINE TEMPERATURE MEASUREMENTS. Arave, A. E. (Aerojet Nuclear Corp., Idaho Falls, Idaho); Christensen, J. A.; Panisko, F. E. Trans. Amer. Nucl. Soc.; 15: No. 2, 766(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5404 DYNAMIC BEHAVIOR OF INTRINSIC THERMOCOUPLE. Kammer, D. S. (Tennessee Valley Authority, Chattanooga); Gat, R.; Hahn, O. J. Trans. Amer. Nucl. Soc.; 15: No. 2, 873-4 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5405 ELECTRON OPTICAL 400 kV SYSTEM FOR TESTING A SUPERCONDUCTING LENS. Dietrich, I.; Weyl, R.; Zerbst, H. (Siemens AG, Munich). pp 120-1 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From fifth European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

A 400-kV electron optical device is described that was built to test an iron-free superconducting shielding lens. A description of the lens and cryostat is also given. The cryostat was designed to test different types of superconducting objective and other lenses. A two-plane beam deflection system is employed, enabling the beam to be displaced and tilted relative to the optical axis. Problems associated with the system are discussed; these are due mainly to inhomogeneities of the superconducting material. In preliminary experiments up to 200 kV beam voltage micrographs were taken from a C foil with pinholes; the sharpness of the pinhole edges indicated a resolution of ~10 Å. (UK)

5406 METHOD OF PRODUCING COLOURED RADIOGRAPHS. van Lishout, J. A.; Jaeken, J. (to Agfa-Gevaert). British Patent 1,286,831. 23 Aug 1972. Filed 22 Aug 1968.

A method for producing color radiographs is described; such radiographs give improved information content in comparison with black-and-white radiographs. The silver halide emulsion layer employed incorporates (a) a colorless color coupler capable of forming an ozomethine or quinonimine dyestuff by coupling with an oxidized aromatic amino developing agent, and (b) a colorless compound capable of oxidative coupling with the colorless color coupler to form a dye. The silver halide is developed with an aromatic amino developer to form radiographic images of the object under investigation that are of contrasting color, and of opposite gradation, the maximum density of one such image being at least 50% of the maximum density of the other. The Ag produced during development is removed with an alkaline oxidizing bleaching solution, thereby effecting the oxidative coupling of (b) with residual amounts of (a). The developing agent may be of p-phemylene diamine type. Suitable compositions for ingredients (a) and (b) are indicated, and these ingredients may be introduced during the development processing. (UK)

5407 INDUCTION TRANSDUCER FOR DETECTING THE VARIATIONS IN THE THICKNESS OF HIGHLY CONDUCTING LIQUID FILMS AT HIGH TEMPERATURE. Blanc, Raymond; Pouvreau, Marcel (to Commissariat a l'Energie Atomique). French Patent 2,105,435. 28 Apr 1972. Filed 7 Sep 1970. (In French).

An induction transducer for detecting the variations in thickness of highly conducting liquid films at very high temperature is described. The sealing of the device enables it to be used in quality control operations carried out in the corrosive environments of nuclear installations. It can be used to control the thickness of a circular film of liquid sodium separating a stainless steel shaft subjected to vibrations, and a stainless steel bearing, the ambient temperature being of the order of 600 deg C. (France)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 5043, 5734, 5758, and 5762.

5408 (LNF–72/49) METHOD OF CALCULATING THE SUSTAINING FORCE OF A MAGNETIC SUSPENSION FOR AN ULTRACENTRIFUGE. Donnetti, M.; Moscati, F.; Veca, G. M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 22 May 1972. 20p. (In Italian). Dep. NTIS (U. S. Sales Only).

A calculation method is proposed for the determination of the map of the magnetic field for a given geometry where the conducting slab is moving in the direction of the axis with the velocity v. There are two external slabs of very high permeability so that at the interior the field from the permanent magnets can be considered zero. (tr-auth)

5409 METHOD AND DEVICE FOR THE SEPARATION OF GASEOUS OR VAPOROUS SUBSTANCES, PARTICULARLY ISOTOPES. Bley, P.; Ehrfeld, W. (to Gesellschaft fuer Kernforschung mbH). German Patent 2,031,687. 13 Jan 1972. (In German).

The method described is applicable to gaseous or vaporous substances with different molecular weights and varying gas kinetic cross sections. The mixture flows through several nozzles which are arranged in parallel in stepwise formation. The expanding beam is thereby divided into a light and a heavy separate jet by means of skimmer blade edges which are arranged within the flow line. Immediately behind the skimmer blade edges, similar jets are combined to one central jet. The staggered nozzles consist of superimposed rings and form a jacket which confines the main jet. (GF)

5410 VALUES OF SEPARATIVE WORK FOR AEROSPACE APPLICATIONS. Altschuler, S. J. (Dow Chemical Co., Golden, Colo.). Trans. Amer. Nucl. Soc.; 15: No. 2, 615-16(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5411 FEASIBILITY AND PROSPECTS FOR PRIVATE SEPARATION AND MARKETING OF POWER REACTOR $^{134,137}Cs$ MIXTURES. McKee, R. W. (Battelle Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 696-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Isotopic Power Sources

Refer also to abstract 5697.

5412 (AECOP–1053) POSSIBLE ^{90}Sr DEMANDS AND AVAILABILITIES. Wood, P. M. (Atomic Energy Commission Combined Operations Planning, Oak Ridge, Tenn.). 30 Sep 1971. Contract W-7405-eng-26. 29p. Dep. NTIS.

The only appreciable market for ^{90}Sr during the next few years is as energy sources for naval applications. Through 1978, the June 1971 NAVFAC requirements are about 45 megacuries of ^{90}Sr. There is probably sufficient, high specific activity strontium scheduled to be reprocessed at the Richland waste encapsulation and storage facility (WESF) to meet the projected naval requirements through 1978. To meet the requirements of these projections after 1978, it would be necessary to find a ^{90}Sr supply other than Richland. A quantity of ^{90}Sr comparable to the Richland supply could be recovered from the waste tanks at the AEC's Savannah River Plant, but at present there are no plans to recover this material. However, by the late 1970s, the commercial power reactors will be producing sufficient quantities of ^{90}Sr in spent fuel to meet all conceivable requirements. At present, no commercial fuel reprocessor has announced plans to recover ^{90}Sr waste streams. Present plans at the Richland WESF are to produce SrF_2, which will be encapsulated in Hastelloy C-276 or Hastelloy C for waste disposal. (J.R.D.)

5413 (CONF-720917–1) PLASMA-ARC WELDING OF AN ISOTOPE CAPSULE. Goodwin, G. M.; Early, B. F. (Oak Ridge National Lab., Tenn.). 1972. 16p. Dep. NTIS.

From second international conference on superalloys: processing; Seven Springs, PA. (18 Sep 1972).

A certain thermoelectric generator uses a ^{90}Sr titanate fuel form contained in a heavy-walled capsule of Hastelloy C, a nickel-base alloy with excellent strength, oxidation, and corrosion properties. The capsule design uses a threaded end cap, with a closure weld to ensure containment. Based upon maximum anticipated seawater corrosion rates, a minimum weld penetration of 0.055 in. is required. Autogeneous gas tungsten-arc (GTA) welding has been used to produce the closure weld in a remote hot-cell environment; however, in the case of certain weldment designs and materials, the attainment of the required penetration by GTA welding presented problems. A plasma-arc welding procedure was developed and successfully applied to four fueled capsules, achieving an average penetration of at least twice the minimum requirement. The plasma process was found to be relatively insensitive to several of the variables which greatly affect penetration in the GTA process. The advantages of the plasma welding process for this application include (1) ease of alignment—a low-current pilot arc can be used to align the torch with the weld joint prior to welding, (2) freedom from stubout and possible tungsten inclusions, (3) freedom from critical arc-length considerations and, most importantly, (4) increased penetration, providing a factor of safety over the minimum penetration requirement. (auth)

5414 (LA–4940) PREPARATION AND EVALUATION OF MEDICAL-GRADE ^{238}Pu FUELS, JULY 1, 1967–JUNE 30, 1971. Mullins, L. J. (comp.) (Los Alamos Scientific Lab., N. Mex.). Oct 1972. Contract W-7405-eng-36. 83p. Dep. NTIS.

The ^{238}Pu requirements, 55 to 90 g, for an artificial heart or circulatory-assist device demand a fuel having minimal radiation properties. Evaluation of potential ^{238}Pu fuel forms has led to development of four satisfactory fuel compositions, electro-refined metal, ^{238}Pu–3 at.% Ga, $^{238}PuN^{15}$, and $^{238}PuO_2^{16}$. Theoretical and experimental studies of these fuels demonstrate that $^{238}PuO_2^{16}$ is the preferred composition for the artificial-heart program. This fuel is prepared as a pressed and sintered oxide. Procedures have been developed for preparing and characterizing cylindrical oxide sources varying in size from 1 to 50 W. The chief sources of undesirable radiation in conventional fuels are low-Z impurity elements and radioactive daughters of ^{236}Pu. The low-Z impurity elements cause an increase in the neutron emission rate over that created by spontaneous fission of ^{238}Pu. This problem is eliminated by using electro-refined plutonium metal whose neutron emission rate is only 1 to 2% higher than that expected from spontaneous fission alone. The problems caused by ^{236}Pu are minimized by using plutonium that contains less than 0.3 ppM ^{236}Pu. Useful techniques based on high-resolution gamma spectrometry have been developed for identification of both low-Z elements and ^{236}Pu daughters in ^{238}Pu fuel materials. (auth)

5415 (ORNL-TM–4035) ISOTOPIC POWER FUELS MONTHLY STATUS REPORT FOR OCTOBER 1972. Lamb, Eugene (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 5p. Dep. NTIS.

Progress on the development of ^{244}Cm for isotopic power fuels is reported. Work continued on procurement of materials and other test-system components for the Cm_2O_3 compatibility program. A short-term compatibility experiment was performed between SiC and CmO_2. Progress on vapor transport of Cm_2O_3 is reported. (T.F.D.)

5416 GAMMA RADIATION MAPPING OF THE TOPS RADIATION TEST MODEL. Davis, H. S.; Price, W. E. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc.; 15: No. 2, 618-19(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5417 DEVELOPMENT OF A $^{238}PuO_2$ SPHERICAL FUEL FORM. Shupe, M. W.; Kent, R. A.; Tokar, M.; Zocher, R. W.; Keenan, T. K. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 685(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5418 PRODUCTION OF ^{238}Pu ISOTOPIC FUELS. Abrahamson, S. G.; Kokenge, B. R.; Elswick, T. C. (Monsanto Research Corp., Miamisburg, Ohio). Trans. Amer. Nucl. Soc.; 15: No. 2, 685-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5419 HELIUM MIGRATION AND RELEASE IN $^{238}PuO_2$ FUEL FORMS. Mueller, B. A.; Mulford, R. N. R. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 686 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5420 RESEARCH ON THERMOPHYSICAL AND THERMOCHEMICAL PROPERTIES OF $^{238}PuO_2$ FUELS. Kent, R. A.; Shupe,

M. C.; Zocher, R. W.; Keenan, T. K. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 686-7(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5421 NEUTRON EMISSION CHARACTERISTICS OF PLUTONIUM DIOXIDE FUEL. Taherzadeh, M. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc.; 15: No. 2, 687-8 (Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5422 PROGRESS IN THE DEVELOPMENT OF ^{244}Cm RADIOISOTOPIC POWER FUEL. McHenry, R. E.; Butler, T. A. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 688-9(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5423 ONE-KILOWATT $^{244}Cm_2O_3$ HEAT SOURCE TEST. Haff, K. W.; Ramey, D. W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 689-90(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5424 RADIATION FIELDS FROM NUCLEAR HEAT SOURCES IN SPACECRAFT OPERATION. Campbell, R. W. (California Inst. of Tech., Pasadena); Koprowski, E. F.; Noon, E. L. Trans. Amer. Nucl. Soc.; 15: No. 2, 690-1(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5425 INTEGRATED WASTE MANAGEMENT/WATER SYSTEM USING RADIOISOTOPES FOR THERMAL ENERGY. Schelkopf, J. D.; Witt, F. J.; Murray, R. W. (General Electric Co., Philadelphia). Trans. Amer. Nucl. Soc.; 15: No. 2, 701-2 (Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5426 ^{60}Co LARGE HEAT SOURCE WITH DYNAMIC CONVERTER. Sinclair, C. E.; Sadler, J. W. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc.; 15: No. 2, 702-4 (Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5427 RADIOISOTOPE PRODUCTION AT LAMPF. Rosen, L.; Dropesky, B. J.; Orth, C. J.; O'Brien, H. A.; Schillaci, M. E. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 704(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5428 MINIATURE NUCLEAR BATTERY FOR CARDIAC PACEMAKERS. Postula, F. D. (Gulf General Atomic Co., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 704-5 (Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5429 PHOTOPEAK UNFOLDING OF THE GAMMA-RAY SPECTRUM MEASURED BY A Ge(Li) DETECTOR. Taherzadeh, M. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc.; 15: No. 2, 712(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Radiation Sources

5430 SAFETY ASPECTS OF ^{137}Cs GAMMA RADIATION SOURCES. Robinson, R. A. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 692-3(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Design and Fabrication

5431 NUCLEAR RESONANCE FLUORESCENCE WITH A 5 Ci Pu–Be RADIOACTIVE SOURCE. White, D. C. S.; Robertson, B. C. (Univ. of Alberta, Edmonton). Nucl. Instrum. Methods; 105: No. 1, 29-32(1972).

The Compton effect was used to obtain a continuous γ-ray source from 4.4 MeV to 0.2 MeV in order to observe nuclear resonance fluorescence. The γ-ray source consists of a 5-Ci Pu–Be source enclosed in a paraffin wax casing, which serves as the Compton scatterer. Results using this method are reported for lifetimes of several excited states in ^{63}Cu and ^{65}Cu. (3 figures, 1 table) (auth)

Industrial Uses

Refer also to abstracts 5105, 5454, 5459, 5460, 5465, 5472, and 5554.

5432 (N–72-24727) RADIOACTIVE NONDESTRUCTIVE TEST METHOD. OBrien, J. R.; Pullen, K. E. (Boeing Co., Seattle, Wash.). Dec 1971. Contract NAS7-779. 69p. (NASA-CR–126655; D–180-14227-1). NTIS.
For Jet Propulsion Lab., Pasadena, Calif.

Various radioisotope techniques were used as diagnostic tools for determining the performance of spacecraft propulsion feed system elements. Applications were studied in four tasks. The first two required experimental testing involving the propellant liquid oxygen difluoride (OF_2): the neutron activation analysis of dissolved or suspended metals, and the use of radioactive tracers to evaluate the probability of constrictions in passive components (orifices and filters) becoming clogged by matter dissolved or suspended in the OF_2. The other tasks were an appraisal of the applicability of radioisotope techniques to problems arising from the exposure of components to liquid/gas combinations, and an assessment of the applicability of the techniques to other propellants. (auth) (STAR)

5433 INVESTIGATIONS OF THE WEAR AND ROTATIONAL BEHAVIOR OF FAST-ROTATING BALL AND ROLLER BEARINGS BY MEANS OF RADIOISOTOPES. Herkert, B. (Kernforschungszentrum, Karlsruhe, Ger.). Motortech. Z.; 33: No. 5, 187-92 (1972). (In German).

Using neutron and deuteron activation, radioisotopes have been produced in all ball and roller bearing elements which allow continuous wear measurement of the activated parts. Low loads result in a high cage slip of fast-rotating ball and roller bearings. Relations between cage slip and shaft motion have been measured. From wear measurements it was found that all bearing elements settle down and thereafter show such a small wear that a lifetime of some thousands of hours is possible. This fact is attributed to the good bearing in the test equipment. During the settling of the balls, relations between slip and wear have been discovered. Small amounts of water in the lubricating oil increase the wear of bearing elements. Punctiform activation of a roller bearing enables the measurement of the roller revolutions, through which the slip behavior of the rollers during one cage revolution can be determined. (GF)

5434 EMPLOYMENT OF RADIOMETRIC METHODS IN INDUSTRIAL MEASUREMENT TECHNIQUES. PART 2. APPLICATION EXAMPLES. Polly, P. (Krohne (Ludwig) K.G., Duisburg, Ger.). Arch. Tech. Messen; 435: 69-74(1972). (In German).

A brief survey is given on the various usual radiometric measurement methods according to the transmission and backscattering methods using β- or γ-emitters or neutrons (moisture gages). The principle of density gages (beta dust meter), thickness gages (area weight, coating), and level gages (gamma limit switch) is discussed in some detail. (GF)

5435 ELIMINATION OF ELECTRIC CHARGES ON POWDERS WITH BETA PARTICLES. Sakanuse, K. (Research Inst. of Industrial Safety, Tokyo). Funtai Kogaku; 8: No. 8, 71-80(Aug 1971). (In Japanese).

Discharging sparks may trigger explosions when static electricity originates at dangerous places where inflammable gas, vapor or dust is present. Corona type charge eliminators neutralize the static charge with ionic charge, and are commonly employed, but are not suitable for such places. Ionization of air utilizing radiation from radioisotope sources does not become an ignition source, accordingly it can be used in static charge eliminators at such places. The radiation to be used as the charge eliminator should have large ionizing capability, and its shielding must be easy. In terms of half life, energy, economy and safety in handling, β-ray from ^{204}Ti and ^{90}Sr is widely employed. Actual elimination of the static charge is carried out by two methods, irradiation type elimination and ionized air blow elimination. The static charge distributes almost uniformly in powder falling through metallic spouts and accumulating in vessels. The β-ray sources used for this experiment were ^{90}Sr and ^{147}Pm. The static charge was measured with a Faraday cage. Value of the static charge on powder scattered according to environmental conditions and handling of insulated vessels containing the powder. Effect for the charge elimination was elucidated at various amounts of the charge on powder, time of the β-ray irradiation, type of the β-ray sources, charge density and thickness of the powder. An experiment was also carried out on freely falling charged powder from a shifter,

to eliminate the static charge by the β-ray irradiation. Mechanism of eliminating the static charge by β-ray does not change essentially in steady state regardless of static or dynamic powder. (Japan)

5436 COMPARATIVE CHARACTERISTICS AND VALUES OF ^{60}Co AND POWER REACTOR ^{134} ^{137}Cs MIXTURES. Cusack, J. H.; Manowitz, B. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 2, 692(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5437 CURRENT AND POTENTIAL RADIATION APPLICATIONS AMENABLE TO USE OF ^{137}Cs AND POWER REACTOR ^{134} ^{137}Cs MIXTURES. Rotariu, G. J. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 693-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5438 PRACTICAL CONSIDERATIONS IN THE INDUSTRIAL USE OF ^{137}Cs AND POWER REACTOR ^{134} ^{137}Cs MIXTURE. Artandi, Charles (Ethicon, Inc., Somerville, N. J.). Trans. Amer. Nucl. Soc.; 15: No. 2, 694-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5439 POTENTIAL MARKET FOR POWER REACTOR ^{134} ^{137}Cs MIXTURES. Wood, P. M. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 695-6 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5440 APPLICATION OF POST-CUTTING CHIP ACTIVATION ANALYSIS TO THE STUDY OF TOOL WEAR. Prasad, K. N. (Bhabha Atomic Research Centre, Bombay); Jester, W. A.; Remick, F. J. Trans. Amer. Nucl. Soc.; 15: No. 2, 717-18(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 5458, 5512, and 5513.

5441 (COO-3233-1) PROGRESS REPORT, AUGUST 16, 1971-AUGUST 31, 1972. Freifelder, David (Brandeis Univ., Waltham, Mass.). 1972. Contract AT(30-1)-3797. 5p. Dep. NTIS.

Progress is reported in the following areas of research: base damage in x-irradiated DNA; natural single-strand breaks in bacteriophage λ; studies on the λ Ter(minase) system; protein monolayer electron microscopy techniques; and mechanisms of lysogenation and insertion of bacteriophage λ. (E.R.B.)

5442 RADIATION EFFECTS ON NUCLEIC ACIDS. Gregoli, S.; Taverna, C.; Rinaldi, A. Cron. Chim.; 29: 18-24(1970). (In Italian).

In order to study the direct effect of radiations on their main biological target, a large amount of work has been performed, especially using the ESR spectroscopy, on the separate constituents of the nucleic acids. The final damage to the molecule of DNA is, however, very different from the simple addition of the damage to the constituents, for in a large number of systems thymine and cytosine appear to be the main site of radiation injury in DNA. These two bases taken separately are, however, not markedly more radiosensitive than the others. What could therefore be taken as a weak point of the DNA molecule is, in fact, a point of convergence of the radiation damage. This convergence must be due either to an energy transfer, or more probably to a radical transfer from one nucleic acid constituent to the other. A study was therefore undertaken on the effect of radiation, not on the separate constituents of nucleic acids but on a series of complexes that they form together. The results of this investigation made it possible to propose a mechanism for the internal redistribution of the radiation damage in these complexes. A similar mechanism could probably account for the preferential destruction of the pyrimidine bases in DNA. (Euratom)

5443 SENSITIVITY OF INVERTASE IN VITRO AND IN VIVO TO GAMMA RADIATION. Giacomelli, M.; Belli-Donini, M. L. (CNEN, Rome). Agrochimica; 16: No. 4-5, 330-3 (1972). (In Italian).

Invertase aqueous solutions at the concentrations of 0,05, 0,1, 0,3,1,0, and 5,0 γ ml were irradiated with gamma and x rays at the doses of 1,5,10,15,30,50,100, and 200 Krads. At the same time, sugar-beets at different periods from harvest were irradiated at the doses of 50,100,150,175, and 200 Krads. Enzymatic activity was measured by Hugget-Nixon method. A rapid decrease in enzymatic activity was noted with doses up to 5 Krads for the water solutions for all concentrations. This behavior is a characteristic of the direct and indirect effect of radiation in a biologically active molecule. The highest effect was reached at the highest concentration as the G-value showed. To explain this phenomenon a hypothesis is presented. Total doses up to 5 krads gave an almost constant enzyme inactivation meaning an independent dose-effect relationship. The lower sensitivity of the enzymatic activity, which was found in vivo system, may be explained both in terms of lower energy received by the molecule or by a higher protection of the enzyme. (auth)

5444 INCORPORATION OF 2-^{14}C-ACETATE IN PHOSPHOLIPIDS AND CHOLESTEROL OF RAT LIVER SUBCELLULAR STRUCTURE AFTER X RAY IRRADIATION. Kolomiitseva, I. K.; Vasil'ev, A. V. Dokl. Akad. Nauk SSSR; 205: No. 1, 237-40(1 Jul 1972). (In Russian).

Stimulation of lipid biosynthesis in animals during irradiation by sublethal and lethal doses of radiation depends not only on a disturbance of energy exchange but on a disturbance of structural elements of the cell. Ionizing radiation impairs lipid components of the biological membrane. The restoration of the phospholipids and cholesterol content in the subcellular organelles of irradiated animals was investigated by studying the incorporation of 2-^{14}C-acetate in the liver subcellular structure of irradiated (800 R) rats. The radiation-induced stimulation effect concerned not only lipid synthesis, but lipid exchange insofar as greater activity was observed in nuclear, lysosomal, and mitochondrial fractions, and lesser activity in microsomal, and also a large percent increase in the specific activity of the phospholipids in subcellular structures in comparison with the homogenate. (K.S.W.)

Radiation Effects on Cells

5445 CHANGES IN TRANSMEMBRANE SODIUM TRANSFER IN IN VITRO IRRADIATED HUMAN RED CELLS. Mombelli, L.; Comotti, L.; Favaro, L. (CURAMN, Varese, Italy). Radiol. Med.; 58: No. 2, 149-56(Feb 1972). (In Italian).

Human red cells were γ irradiated in vitro with 1,600 R, labeled with ^{22}Na, and incubated with or without ouabain. Observed changes in sodium elimination from red cells are seen as due to reduced sodium pump efficiency caused by reduction of intraglobular ATP concentration levels. (auth)

5446 PREMITOTIC DEATH AND CHROMOSOME ABERRATIONS IN IRRADIATED LYMPHOCYTES: THEIR POTENTIAL RELEVANCE TO THE ROLE OF MEMBRANE DAMAGE. Hornsey, Shirley (Medical Research Council, London). Curr. Top. Radiat. Res. Quart.; 7: No. 3, 359-62(Jun 1972).

From third L. H. Gray memorial conference on radiation effects and the mitotic cycle; Manchester, England (5 Jan 1971). See CONF-710120.

A review of studies on effects of radiation dose on numbers of intact lymphocytes in culture after stimulation with phytohemagglutinin showed that there was a loss of cells before the first mitosis following irradiation. The dose effect curve for chromosome aberrations and oxygen enhancement ratio is discussed in relation to damage to the nuclear membrane. It is suggested that cell death may result from primary events in two main targets that are affected to a different extent by the presence of oxygen: DNA and the nuclear membrane. (H.L.W.)

5447 INVESTIGATION ON THE EFFECT OF γ-IRRADIATION ON THE HYPOXANTHINE-GUANINE-PHOSPHORIBOSE-PYROPHOSPHATE-TRANSFERASE SYSTEM IN HUMAN ERYTHROCYTES. Eberl, R.; Altmann, H.; Partsch, G. (Institut fuer Biologie, Seibersdorf, Austria). Stud. Biophys.; 33: No. 2, 137-44(1972). (In German).

The hypoxanthine-guanine-phosphoribosepyrophosphate-transferase system is very radioresistant. In contrast to the isolated enzyme that shows no activity after 5 Mrad, in vivo irradiation of erythrocytes cause only a reduced activity to 65% of the unirradiated control. A small stimulating effect was observed when irradiation of an erythrocyte lysate was performed with low doses (10 Krad). (auth)

5448 EFFECT OF LOW DOSE RATE IRRADIATION ON THE DIVISION POTENTIAL OF CHICK EMBRYONIC FIBROBLASTS. Lima, L.; Malaise, E.; Macieira-Coelho, A. (Institut Gustave-Roussy, Villejuif, France). Exp. Cell Res.; 73: No. 2, 345-50(1972).

Three chick embryo fibroblastic lines were propagated in vitro to study the effect of low dose rate irradiation on the following parameters: saturation density, % of dividing cells, number of passages, and total amount of cells produced. The plot of the saturation densities showed that the curves corresponding to the irradiated cultures were parallel to the curves of the controls but that the growth decline started earlier in the former. The percentage of dividing cells was unchanged and the number of passages was slightly reduced in irradiated cultures. The reduction in the total number of cells produced was directly proportional to the total number of rads received. Results suggest that even very small doses of radiation may have long term damaging effects on normal tissues in vitro. (auth)

5449 DIFFERENTIAL RESPONSES OF SEVERAL ANEUSOMIC CELL CLONES TO ULTRAVIOLET IRRADIATION. Kato, H.; Yosida, T. H. (National Inst. of Genetics, Mishima, Japan). Exp. Cell Res.; 74: No. 1, 15-20(Sep 1972).

Several aneusomic clones were isolated from a pseudodiploid Chinese hamster cell line, and their sensitivities to uv light were compared on the basis of their colony-forming abilities. It was found that trisomic and monosomic clones were both more sensitive than the parental control line, the monosomic clone being the most sensitive of all. A disomic clone was isolated from a long-term culture of the monosomic clone. This clone was found to be more resistant to uv irradiation than the monosomic one, while apparently more sensitive than the control disomic line. It was considered that the disomic cell had arisen through duplication of a monosomic chromosome in a monosomic cell by nondisjunction, thus possessing two identical chromosomes. The increased uv sensitivity of aneusomic clones was discussed in terms of the change in chromosomal constitu-

tion that might alter the activity of various enzymes. Karyotypes of these clones were examined with reference to their chromosomal banding patterns induced by a newly developed technique. (auth)

5450 FURTHER STUDY ON THE MORPHOLOGY AND BIOCHEMISTRY OF X-RAY AND DIBUTYRYL CYCLIC AMP-INDUCED DIFFERENTIATED NEUROBLASTOMA CELLS IN CULTURE. Prasad, K. N.; Waymire, J. C.; Weiner, N. (Univ. of Colorado, Denver). Exp. Cell Res.; 74: No. 1, 110-14(Sep 1972).

Dibutyryl cyclic AMP-induced morphological differentiation of mouse neuroblastoma cells in culture required the synthesis of new protein but not of new RNA. An appreciable increase in RNA synthesis, a slight increase in protein synthesis and a marked decrease in DNA synthesis occurred in the dibutyryl cyclic AMP-induced differentiated cells. Tyrosine hydroxylase activity which is barely detectable in the control neuroblastoma culture markedly increased after treatment with dibutyryl cyclic AMP. Sodium butyrate, which inhibited cell division without causing morphological differentiation also increased tyrosine hydroxylase activity, but to a lesser degree. 3′5′ Cyclic AMP and 5′ AMP which inhibited cell division without causing morphological differentiation did not increase the enzyme activity. X-irradiation produced inhibition of cell division and morphological differentiation similar to that observed with dibutyryl cyclic AMP, but the tyrosine hydroxylase activity did not increase. The irradiated cells, nevertheless, retained the potential to manifest increased tyrosine hydroxylase levels upon subsequent exposure to either dibutyryl cyclic AMP or sodium butyrate. The present data suggest that increased tyrosine hydroxylase levels in neuroblastoma cells is not inextricably linked to morphological changes which are presumed to reflect cellular differentiation. (auth)

Radiation Effects on Microorganisms

5451 MUTAGENIC EFFECT OF ULTRAVIOLET IRRADIATION AND ETHYLENE IMINE ON NEOMYCIN PRODUCING STRAIN OF STREPTOMYCES FRADIAE. Bhadra, R.; Majumdar, S. K. (Jadavpur Univ., Calcutta). Indian J. Exp. Biol.; 10: No. 3, 224-7(May 1972).

Ethylene imine is a superior mutagen for the development of high yielding stable variants of S. fradiae while ultraviolet light is suitable for point mutation. The greater portion of the variants with high antibiotic potency does not differ morphologically from the parent strain, while the major morphological variants are low yielding varieties. The colour variants are mostly non-producers of the antibiotic. The combination of ethylene imine and ultraviolet light appears to be more promising for the mutagenic effect in the development of high yielding mutants. (auth)

5452 LIQUID-HOLDING AND RECOVERY FROM UV-INDUCED DAMAGE IN EUDORINA ELEGANS. Kemp, C. L. (Simon Fraser Univ., Burnaby, B. C.). Arch. Mikrobiol.; 86: 255-64(1972).

Eudorina elegans does not respond to liquid-holding or to post-irradiation medium effects by changes in recovery. A decrease in survival ability is observed if a culture is starved prior to irradiation, or is incubated at 22°C rather than 32°C following uv irradiation. Eudorina loses the ability to photoreactivate uv damage within 10 to 48 hr following irradiation, depending upon the pre- and post-uv culture conditions. The results are interpreted as indicating a failure of Eudorina elegans to carry out specific dark repair of uv damage. Some reactivation may occur during cellular DNA synthesis. (auth)

5453 INDUCED VARIATIONS IN MICROORGANISMS. I. MUTAGENIC EFFECT OF ULTRAVIOLET LIGHT ON RHIZOBIUM TRIFOLII. Kaushik, B. D.; Venkataraman, G. S. (Indian Agricultural Research Inst., New Delhi). Folia Microbiol. (Prague); 17: No. 5, 381-8(1972).

The mutagenic effect of ultraviolet light on a strain of Rhizobium trifolii T5 was studied. A gradual build-up of radioresistance in the population of the wild cells was observed as a result of cyclic uv irradiation, although there was no definite indication for a plateau of maximal resistance of the population even after 20 cycles of irradiation. The radio-resistance was built up sooner in a population cycled at a low dose of irradiation (3 sec) than at a high dose (10 sec). The fluctuation test indicated that uv acted as an inducing agent. The frequency of radioresistant cells in a radiation cycled population was about 6.8×10^{-6} as against $c.4 \times 10^{-6}$ in the nonirradiated population. Five mutants were examined in detail, in which radioresistance in two was accompanied by resistance to streptomycin also. The mutants did not differ drastically from the wild strain in their biochemical properties, salt tolerance and clover infectivity. No uv induced auxotrophic mutants were detected. (auth)

5454 EFFECT OF IONIZING RADIATION ON GEOTRICHUM CANDIDUM TO PROLONG THE STORAGE LIFE OF LEMON. Mahmood, T. (Ege Univ., Izmir, Turkey). Plant Dis. Rep.; 56: No. 7, 582-5(Jul 1972).

Ionizing radiations were used in vitro and in vivo against Geotrichum candidum, the cause of sour rot of lemon, to determine the possibility of prolonging storage life. Tests in vitro showed that a dose of 250 Krad and above caused a break in the colony-inducing potential of the arthrospores. A dose of 200 to 250 Krad remarkably delayed the germination of arthrospores by 20 to 40 hr. Tests in vivo showed that a dose of 200 Krad was suitable for the control of sour rot decay in lemons. Exploitation was not found to be economical, however, because such a dose always changed the organoleptic properties of the lemon fruits. (auth)

5455 EFFECTS OF ERGOSTEROL, PALMITIC ACID, AND RELATED SIMPLE LIPIDS ON THE RECOVERY OF CANDIDA ALBICANS FROM ULTRAVIOLET IRRADIATION. Sarachek, A.; Higgins, N. P. (Wichita State Univ., Kan.). Arch. Mikrobiol.; 82: 38-54(1972).

Post-irradiation growth on sterols or long chain fatty acids promotes recovery of Candida albicans from uv-induced lethal damage. The effect is observed only for cells that are not budding at the time of irradiation. Lipids have no effect on uv mutagenesis. A survey of a number of sporogenous and asporogenous yeasts indicates that the capacity for lipid-induced recovery from uv is a species specific characteristic of yeasts. The behaviors of cells damaged by uv and by amphotericin B, a membrane specific fungicidal antibiotic, suggest that lipids remediate an uv-induced derangement of the structure of the cell membrane critical for the initiation of cell division. (auth)

5456 EVALUATION OF THE NUMBER OF IRREVERSIBLE ADSORBED PARTICLES OF BACTEPIOPHAGE T1 ON THE E. COLI CELLS BY UV-IRRADIATION OF A FREE OR INTRACELLULAR PHAGE AND PLATING ON THE HCR^+ AND HCR^- LAWN. Mosin, A. F.; Petrova, K. M.; Tsyb, T. S. (Inst. of Medical Radiology, Obninsk, USSR). Stud. Biophys.; 30: No. 1, 9-16(1972). (In Russian).

The adsorption of T1 phage includes reversible and irreversible steps. The routine method for the evaluation of the number of irreversible adsorbed particles consist in the dilution of a suspension with preadsorbed phage, centrifugation, and determination of quantity of plaque forming units in the pellet. This method is rather difficult and sometimes not correct. In this work we offer a new, simpler, and more correct method for this purpose. The principle of that method consists in uv irradiation of phage (before or after preadsorption) and plating on the "lawn" from hcr^+ and hcr^- bacteria. The following steps are the cause of this method. 1. Plating efficiency of unirradiated phage on hcr^+ "lawn" is the same as on hcr^- "lawn". 2. The survival of phage uv-irradiated in a free state is much larger on hcr^+ than on hcr^- "lawn". 3. The viability of irreversible adsorbed phage exposed to uv light (before or after adsorption) on hcr^+ "lawn" does not differ from viability on hcr^- "lawn". 4. The survival of reversible adsorbed phage after uv irradiation is the same as the one in a free phage. The equation for estimation of percentage of irreversible adsorbed phage is: $100\% - (X_t - Y_t/X_o - Y_o) = \%$ irreversible adsorbed particles, where X_t and Y_t is the survival of uv-irradiated and preadsorbed (or vice versa) phage on the hcr^+ and hcr^- "lawn" respectively; X_o and Y_o —the survival of phage exposed to uv light in a free state and plated (without preadsorption) on the hcr^+ and hcr^- "lawn" respectively. The decreasing of the number of unadsorbed and reversible adsorbed phages judging by this method is exponential. The rate of adsorption of phage on E. coli B cells is the same as on E. coli Bs-1 cells. It does not depend on what kind (irradiated or unirradiated) of phage was used. The evaluation of the number of irreversible adsorbed phages in M-9 + yeast extract media or in a phosphate buffer by uv irradiation and plating on hcr^+ and hcr^- "lawn" ("method of 'lawn'") in the experimental conditions seems to be more correct by comparing with the method of dilution and centrifugation. (auth)

5457 POTENTIALLY LETHAL DAMAGE AFTER GAMMA IRRADIATION IN CHLORELLA CELLS (GREEN UNICELLULAR ALGA). Gilet, Roland (CEN, Grenoble, France). Stud. Biophys.; 30: No. 1, 37-44(1972).

The cellular cycle of Chlorella, a photosynthetic unicellular alga, seeded from mass cultures "au plateau" on mineral nutrient solution, is resumed only if the cells are illuminated. In this way, the resumption of the cycle can be delayed for a time T after γ irradiation. The survival rate increases when T increases

from 0 to 6 hrs and remains constant after 6 hrs. This fact is not so clear if the irradiated samples are taken from cultures at the beginning of the plateau phase. (auth)

5458 KINETIC MODEL OF RADIATION DAMAGE OF VIRAL AND BACTERIAL DNA. **Ronto, Gy.; Karczag, A.; Tarjan, I. (Medical Univ., Budapest). Stud. Biophys.; 33: No. 2, 121-30 (1972). (In German).**

A kinetic model of the uv damage of viral and bacterial DNA is described. The model proceeds from the assumption that there are discrete, disjunct, disturbable sites on the DNA, which may be in the state of "disturbed" and "undisturbed". By the absorption of a photon, the undisturbed site changes with the probability α to the reversibly and with the probability δ to the irreversibly disturbed state, the reversibly disturbed site changes with the probability γ to the undisturbed state. In connection with plaque formation, α and γ were determined for phage T7, α, γ and δ for phage MS2. The results obtained and possible extensions of the model are discussed. (auth)

5459 STUDIES ON THE PRESERVATION OF PORK SAUSAGE BY GAMMA RADIATION. 1. ON THE ENHANCEMENT OF THE PRESERVATIVE EFFECT OF ANTISEPTICS BY GAMMA RADIATION. **Kim, Y. J.; Park, Y. K.; Suh, D. Y. Han'guk Sikp'um Kwahakhoe Chi; 4: No. 2, 100-5(1972). (In Korean).**

This experiment was conducted to investigate the combined effects of radiation and antiseptics on the keeping qualities of pork sausage, which was treated with potassium sorbate and AF-2 (2-furyl)-3-(5-nitro-2-furyl)-acrylamide), and then followed by gamma radiation of 0.25, 0.5, and 0.76 Mrad. Amounts of treated antiseptics were a quarter, half, and full levels of their maximum permissible concentration. Irradiated and unirradiated sausages were stored for 50 days at 5°C and 25°C, and their changes in rancidity, volatile basic nitrogen, bacterial counts, pH, and sensory analysis were examined during the storage period. The results obtained are as follows: Preservative effects of antiseptics were manifested at cold storage; antiseptics treatment of a quarter-level and unirradiation following low-temperature storage showed the same good keeping qualities as the combined of full-level antiseptics and radiation of 0.25 Mrad following high-temperature storage. There did not appear to develope irradiation-odor, while color and odor were deteriorated intensively by storage temperature. Sausage irradiated with 0.75 Mrad has shown slightly noticeable off-odor at the end of storage at 25°C. The best radiation dose was considered to be 0.5 Mrad, which could extend the storage life about 2 to 3 times longer than untreated. (Korean Sci. Abstr.)

5460 STUDIES ON THE PRESERVATION OF RAW BEEF BY GAMMA RADIATION. **Kim, Y. J.; Park, S. K.; Kong, U. Y. Han'guk Sikp'um Kwahakhoe Chi; 4: No. 2, 95-9(1972). (In Korean).**

Studies were made to investigate the influence of vacuum packing after irradiating mean doses of gamma ray at freezing temperature (–20°C) on the keeping quality and color of raw beef. Fresh round steaks were packaged anaerobically in aluminum foil, and irradiated with 0.25 and 0.5 Mrad followed by storage at 5°C. The shelf life of beef irradiated with 0.5 Mrad could be extended about 10 days longer than unirradiated, and the off-odors were not developed. The discoloration by irradiation was shown, but soon reverted to about 90 percent myoglobin in 20 hrs. (Korean Sci. Abstr.)

5461 DEOXYRIBONUCLEIC ACID REPAIR IN BACTERIOPHAGE T4: OBSERVATIONS ON THE ROLES OF THE x AND v GENES AND OF HOST FACTORS. **Mortelmans, K.; Friedberg, E. C. (Stanford Univ., Calif.). J. Virol.; 10: No. 4, 730-6(Oct 1972).**

Studies were carried out to determine the effect of mutation in the host pol I gene on survival of ultraviolet (uv)-irradiated bacteriophage T4. Whereas a slightly reduced survival was observed in Escherichia coli strain P-3478 (pol A_1) compared to strain W-3110 (pol A^+), no such difference was observed in two strains isogenic except for the pol A gene. It was also shown that, whereas bacteriophage T4x is sensitive to uv irradiation, x irradiation, and treatment with methylmethanesulfonate (MMS), phage T4ν_1 is sensitive only to uv irradiation. The survival of damaged phage T4x is neither affected by the presence of the rec A, rec B, or pol A mutations in the host, nor is there evidence that phage T4 effects repair of rec A or pol A mutants previously treated with either uv or MMS. (auth)

5462 IN VITRO REPAIR OF X-IRRADIATED DNA EXTRACTED FROM BACILLUS SUBTILIS DEFICIENT IN POLYMERASE I (DNA LIGASE/GENE REPAIR/TRANSFORMATION). **Laipis, P. J. (Princeton Univ., NJ); Ganesan, A. T. Proc. Nat. Acad. Sci. U. S. A.; 69: No. 11, 3211-14(Nov 1972).**

DNA extracted from x-irradiated cells of a mutant of Bacillus subtilis deficient in DNA polymerase I has greatly reduced biological activity. This DNA, which has many single-strand nicks, can be repaired in vitro with purified DNA polymerase I and DNA ligase or with lysates of wild-type B. subtilis cells, which restore biological activity and increase the single-strand molecular weight. Lysates of polymerase I-deficient B. subtilis cells cannot repair such irradiated DNA until purified DNA polymerase I or lysate from wild-type cells is added to the deficient lysate. (auth)

5463 INDUCED VARIATIONS IN MICROORGANISMS. III. GENETIC TRANSFER BETWEEN INTACT CELLS OF THE MUTANTS OF RHIZOBIUM TRIFOLII. **Kaushik, B. D.; Venkataraman, G. S. (Indian Agricultural Research Inst., New Delhi). Folia Microbiol. (Prague); 17: No. 5, 393-5(1972).**

Genetic transfer of markers has been found to occur through a sexual cycle between intact cells in a mixed culture of two different genotypes. When rS (radiosensitive and streptomycin resistant) and Rs (radioresistant and streptomycin sensitive) cells of Rhizobium trifolii were brought into varying periods of cellular contact, the cell mixture yielded RS recombinants. The recombination frequency was higher in young mating cultures than in aged ones. Except for the acquisition of the R and S markers, the recombinants did not differ appreciably from the parental strains in other characters. (auth)

5464 IRRADIATION STERILIZATION OF SHIGELLA SONNEI ANTIGENS. **Thilo, W.; Butte, H.; Koch, W. (Staatliche Institut fuer Serum- und Impfstoffpruefung, Berlin). Z. Gesam. Hyg. Ihre Greenzgeb.; 17: 615-17(Aug 1971). (In German).**

Following $^{60}Co\gamma$ irradiation at 8.2×10^5 R, antigen production was stopped completely in Shigella sonnei. The antigens, produced according to the Frier–Tau procedure, were tested secondarily with approximately 10,000 germs (Bacillus cereus var. mycoides). Animal experiments showed that the ED_{50} and LD_{50} values were in the same range as those obtained with non-contaminated and non-irradiated antigens. (tr-auth)

5465 EFFECT OF IONIZING RADIATION ON THE MICROBIOLOGICAL CONTENT AND VOLATILE CONSTITUENTS OF SPICES. **Tjaberg, T. B.; Underdal, B.; Lunde, G. (Agricultural Coll. of Norway, Vollebekk). J. Appl. Bacteriol.; 35: No. 3, 473-8(Sep 1972).**

Gamma-irradiation at a level of 0.5 Mrad decreased the number of surviving microorganisms in white pepper, nutmeg, and ginger considerably and 1.58 Mrad sterilized them. Gas chromatography showed a slight increase in the amounts of voltatile constituents with increasing dose. The amounts of permanent free radicals in the spices were negligible. (auth)

Radiation Effects on Plants

Refer also to abstract 5443.

5466 (EUR-4868) APPLICATION OF ATOMIC ENERGY IN AGRICULTURE. **Annual Report, 1970. (European Atomic Energy Community. Instituut voor Toepassing van Atoomenergie in de Landouw, Wageningen (Netherlands)). Oct 1972. 90p. Dep. NTIS (U. S. Sales Only). EUR B.Fr. 125.-.**

Mutation Breeding and Radiation Genetics: Much attention was given to the irradiation with low doses of food products, which contain a relatively high percentage of substances such as fats and proteins. This in order to try to by-pass side-effects such as off-odors and off-flavors. The jointly set up research, between Denmark, the Association and the National Institute of Health in Utrecht, into an improvement the wholesomeness-testing technique was continued. Furthermore a German-Dutch cooperation, aiming at integration of food irradiation programs in both countries, was set up. Finally, cooperation was given to the project concerning the testing of irradiated food set up by OECD (Organization for Economic Cooperation and Development) and IAEA (International Atomic Energy Agency). Genetic Control of agricultural insect pests: Besides the research into the application possibilities of the sterile male technique, which, in cooperation with the Institute for Phytopathological Research and the Department of Entomology of the Agricultural University in Wageningen, will lead to the first practical tests in 1971, a start has been made into the effect of radiation induced translocations in the onion fly and spider mite. Radioisotope Techniques in Soil-Plant Research: The research into the transport of ^{90}Sr in different European soil types has been completed. Due to the good agreement between the

calculated (simulation technique) and measured profiles, it is now possible to forecast the behavior of ^{90}Sr in the soil under different environmental (soil, climate) conditions. Dosimetry: Research into radiation interaction in crystals and polymers is almost completed. The follow-up studies on biochemicals have already started. Dosimetry systems for practical applications (thermoluminescence of LiF and CaF_2 and the optical density of pretreated perspex) have been made considerably more reliable as a result of a better insight into the primary processes occurring in these systems. Owing to this, it was possible to carry out at the Associations Institute a dose comparison for fourteen radiobiological Institutes from eight European countries in close cooperation with the Radiobiological Institute in Rijswijk. Applications: As far as the applications are concerned, it must be mentioned that the fresh mushrooms have been put on the market in Holland as the first irradiated food-stuff, and that a Study Committee has intensively prepared the way for the commercialization of irradiated potatoes. In the field of mutation breeding, a number of mutants of flowering plants (e.g., Alstroemia) were also put on the market. With regard to the genetic control of agricultural insect pests, research carried out jointly with institutes of entomology has reached such a stage that the first practical tests with sterile males of the onion fly and the fruit tree leaf roller were started in 1971. (auth)

5467 (TID-26213) DEVELOPMENT OF A MUTAGENICITY TESTING SYSTEM BASED UPON NEW DRUG-RESISTANT MUTANTS OF NEUROSPORA CRASSA. Hoffmann, G. R. (Tennessee Univ., Knoxville). Aug 1972. 161p. Dep. NTIS.

Thesis.

A new system for the detection of forward mutations from drug sensitivity to resistance has been developed in a heterokaryon of Neurospora crassa. In developing this system, new mutants resistant to 8-azaguanine or to 5-fluorodeoxyuridine (FdUrd) were induced and described. Mutants resistant to inhibitory concentrations of 5-fluorodeoxyuridine were induced by ultraviolet light. Resistance was demonstrated in growth tubes and in plating efficiency experiments. Linkage studies revealed the existence of at least two loci conferring resistance to FdUrd. These loci, designated fdu-1 and fdu-2, were assigned to Linkage Groups VII and IV, respectively. The resistance markers were recessive to their sensitive alleles in heterokaryons. Attempts to detect mutants in a two-component heterokaryon carrying an fdu-1 or fdu-2 gene in one component were unsuccessful because background growth in the presence of the inhibitor obscured the development of mutant colonies. Under conditions of limited-adenine supplementation, 8-azaguanine is a potent inhibitor of purine auxotrophic strains of Neurospora crassa. It is relatively ineffective in prototrophic strains. Spontaneous and ultraviolet-light-induced mutants resistant to 8-azaguanine were obtained in a strain carrying the ad-2, ad-3A, and ad-3B markers. Resistance was demonstrated both by plating efficiencies and in growth tubes. Growth-tube experiments were also used to study the reversal of 8-azaguanine-induced inhibition by adenine sulfate. Resistance to 8-azaguanine was stable in the presence and in the absence of the inhibitor. The characteristic was recessive in heterokaryons. The resistance markers in the five strains studied were assigned to Linkage Group III. The locus designation aza-3 was given to the resistance marker in a selected mutant of spontaneous origin. A selection medium was developed for the direction of 8-azaguanine resistant mutants in adenine-requiring heterokaryons carrying the aza-3 gene. Mutants were detected in the new system after treatment of conidia with ultraviolet light, x-rays, ethylmethanesulfonate, or the acridine mustard, ICR-170. The frequency and pattern of appearance of mutant colonies and various factors in mutant selection are discussed. (auth)

5468 RADIOLYTIC CHANGES IN THE STRUCTUREDNESS OF THE CYTOPLASM AS STUDIED IN VIVO. Cercek, Lea (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Curr. Top. Radiat. Res. Quart.; 7: No. 3, 355-8(Jun 1972).

From third L. H. Gray memorial conference on radiation effects and the mitotic cycle; Manchester, England (5 Jan 1971). See CONF-710120.

A brief review is presented of studies on radioinduced physicochemical changes in the cytoplasm of root-cap cells of barley and of yeast cells. Effects of temperature, LET, oxygen, and radiosensitizers such as NEM, para-nitro-acetophenone, and methylglyoxal, on radioinduced changes are discussed. It is concluded that radiosensitizers exert their effects by increasing structuredness, thereby creating conditions which inhibit repair processes, whereas irradiation under hypoxic conditions or in the presence of radioprotective agents decrease the structuredness facilitating diffusion-controlled reactions. (H.L.W.)

5469 ROLE OF β-IRRADIATION ACCOMPANYING THE DECAY OF ^{32}P INCORPORATED IN YEAST DIPLOID CELLS IN INDUCTION OF RECOMBINANTS. Gracheva, L. M.; Korolev, V. G. (Ioffe Inst. of Physics and Tech., Leningrad). Genetika; 8: No. 9, 84-91(Sep 1972). (In Russian)

The induction of mitotic recombination in diploid cells of Saccharomyces cerevisiae by β-rays was studied. The effect of external β irradiation was compared with that of internal self-irradiation when ^{32}P was incorporated into cells. The dose of β irradiation was calculated for both cases. Experimental data and calculations showed that the efficiency of external β irradiation comprised about 25% of the effect of transmutation β irradiation. Yeast cells sensitive to the recombinogenic effect of β irradiation were characterized by sensitivity to the lethal and mutagenic effects of this radiation. (auth)

5470 EFFECT OF CHRONIC GAMMA IRRADIATION ON GENE RECOMBINATION IN PEAS. Monti, L. M. (CNEN, Rome). Z. Pflanzenzuecht.; 68: No. 1, 64-72(1972).

Reciprocal crosses were performed between two pea lines one of which was characterized by 10 recessive marker genes. The parents and both the plants of the reciprocal F_1 crosses were chronically irradiated in a gamma field. Data on the effects of the irradiation on the treated plants were collected and a clear dose effect appears for all the parameters considered for estimating radiosensitivity; no difference was found between the reciprocal hybrids. An F_2 analysis was carried out on material coming from the control and the irradiated plants and recombination data among some linked marker genes were collected: no influence of the irradiation was detected on chromosome III (genes st and b) and VII (r and tl); on the contrary, recombination values among three marker genes (s, wb, k) localized in chromosome II increased after irradiation: linkage between s and wb changed from 9.5% to 14.4%, that between wb and k increased from 14.4% to 18.6% and that between s and k from 21% to 24%. The research shows that a higher frequency of crossovers can be obtained by chronic radiation treatment of F_1 plants; the results are explained on the basis of an interference of radiations in the repair concerned with the recombination process. (auth)

5471 MUTAGENESIS AND MUTANT SELECTION IN PHYSARUM POLYCEPHALUM. Haugli, F. B.; Dove, W. F. (Univ. of Wisconsin, Madison). Mol. Gen. Genet.; 118: No. 2, 109-24(1972).

Physarum polycephalum myxamoebae were exposed to ultraviolet irradiation and plated in the absence and presence of caffeine. Caffeine reduces the shoulder on the uv^1 dose-survival curve, thereby increasing the uv-sensitivity for survival. Caffeine alone is a moderate mutagen. Used in conjunction with uv a strong mutagenic action is observed. Active growth is required for both of these mutagenic actions. Populations of Physarum myxamoebae mutagenized with NMG or EMS could be enriched for two classes of mutants by incubating at high temperature (30°C) with 5-bromodeoxyuridine-substituted bacteria followed by irradiation with long wave uv light and recovery at low temperature (23°C). One class of mutants was obtained in high yields after repeated cycles of light inactivation. These are not heat sensitive. Rather they are defective in utilization of DNA precursors provided by the bacteria. The other mutant class, obtained in low yields after limited selection, are heat sensitive. Three independent mutants of this kind, all eaky, were obtained. Reconstruction experiments show that all are selectants. (auth)

5472 STUDIES ON THE STORAGE OF ONIONS BY RADIATION. 1. Park, N. P.; Choi, E. H.; Byun, K. E. Han'guk Sikp'um Kwahakhoe Chi; 4: No. 2, 84-9(1972). (In Korean).

An experiment was carried out to investigate the optimum doses of gamma irradiation for sprouting inhibition of onion bulbs with irradiation time and storage conditions. The results obtained are as follows: The irradiation doses of 5, 7, and 10 krad, respectively, at 11, 32, and 66 days after harvest were sufficient to inhibit subsequent sprout of onion bulbs obtained from Nampyeong district. When they were irradiated at 96 days after harvest, however, there was little sprout-inhibition by 15 krad. In the case of onion bulbs obtained from Changnyeong district, sprout was inhibited by doses of 8 and 12 krad respectively, at 51 and 89 days after harvest. Low-temperature storage after irradiation was not effective in sprout-inhibition of onion bulbs. Onion bulbs stored at low temperature of 5°C rather showed higher sprouting rate as compared with that of room temperature. Rot increased in irradiated lot and at room temperature, and spores of Aspergillus sp. were little germinated at a level of 100 krad. The respiratory rate of irradiated onion bulbs was higher immediately after irradiation but lower one week after irradiation than control. Respiratory quotient of tissues seems to be little affected by gamma irradiation. (Korean Sci. Abstr.).

5473 RADIOSENSITIVITY AND DISTRIBUTION OF COMMON MACRO-FUNGI IN A CHRONICALLY IRRADIATED OAK–PINE FOREST. Holt, B. R. (Brookhaven National Lab., Upton, NY). Radiat. Bot.; 12: No. 5, 339-42(Oct 1972).

The maximum radiation tolerances observed among the macrofungi in the Brookhaven Irradiated Forest over a period of 8 yr were intermediate between those previously observed for angiosperms and micro-fungi. Reproduction of Armillaria mellea (Basidiomycota, Agaricales) and Lycogala epidendrum (Myxomycota, Liceales) was more sensitive to radiation-induced changes in microclimate and the rapidity of host death than it was to radiation itself. Lycoperdon pyriforme (Basidimycota, Lycoperdales) apparently responded directly to radiation. (auth)

5474 STORAGE MODIFIED EFFECTS OF MONENERGETIC FAST NEUTRONS ON NIGELLA CHROMOSOMES. Thakare, R. G.; Moutschen, J. H. (Univ., Liege). Radiat. Bot.; 12: No. 5, 343-8(Oct 1972).

Nigella seeds were irradiated with monoenergetic neutrons (0.43 and 0.65 MeV) at three different doses up to 353 rad, stored for six years (at 22°C, 55% relative humidity), then germinated and the root meristem cells examined for chromosomal aberrations. With storage there was an increase in frequency of chromosomal aberrations in both the unirradiated controls as well as in seeds that were exposed to 0.65 MeV neutrons. Further analyses of the results showed that whereas the number of breaks (acentric fragments) was decreased, the number of minutes and exchanges was considerably enhanced. The long period of storage did not appear to modify the incompleteness of rejoining, but the localization of the sites of damage was altered in that the proportion of changes localized at the ends of the chromosomes was higher. (auth)

5475 EFFECT OF LOW DOSES OF GAMMA RADIATION ON YIELD AND OTHER AGRONOMIC CHARACTERS OF SPRING WHEAT (TRITICUM AESTIVUM). Fowler, D. B.; MacQueen, K. F. (Dept. of Agriculture, Ottawa). Radiat. Bot.; 12: No. 5, 349-53(Oct 1972).

In each of three years, seed of three spring wheat (Triticum aestivum) cultivars were irradiated with low doses of gamma radiation from ^{60}Co prior to planting. The absorbed doses received by the seed were 100, 300, and 1000 rad in all three years and in addition, 1500 rad in the third year. These treatments did not result in any practical change in plant height, date of maturity, seed yield, hectoliter weight, 1000 kernel weight, or seed protein content. However, consistent, small differences in yield could be found for irradiated populations and for the 1970 test year these differences were statistically significant. A similarity between the reported effects of low dose irradiation and other biological phenomena was noted. Based on observations made on these events and the effects of low dose irradiation reported in the literature, a hypothesis is advanced that would directly attribute most of the reported stimulation effects of low dose irradiation to increased seedling vigor, early modifications in the pattern of axillary bud development, and changes in the initial rate of floral differentiation. The detection and reproduction of the effects of low dose irradiation on yield are discussed. It is suggested that environment has a large and variable influence on the extent to which stimulation effects are carried through and expressed as increased seed yield. It is further suggested that the precision of yield measurements in conventional small plot trials may not be sufficient to consistently detect yield increases of the magnitude induced by low dose irradiation of seeds. (auth)

5476 STRUCTURE AND YIELD OF A CHRONICALLY IRRADIATED WINTER RYE-WEED COMMUNITY. Holt, B. R.; Bottino, P. J. (Brookhaven National Lab., Upton, NY). Radiat. Bot.; 12: No. 5, 355-9(Oct 1972).

The response of a rye crop (Secale cereale) and its weed associates (Capsella bursa-pastoris, Conyza canadensis, and Lepidium virginicum) to a gradient of chronic gamma radiation was examined in the Brookhaven gamma field. Plants were counted and shoots harvested in three 0.25 m^2 quadrats at each of fifteen distances from a 4100 Ci ^{60}Co source. Exposure rates varied from 610 to 3.4 R/day. Rye dominated the biomass and productivity of the community at exposure rates below 50 R/day; weeds dominated between 50 and 610 R/day. The productivity of the community declined markedly as rye was eliminated, but stabilized between 50 and 500 R/day as the major weeds sequentially assumed dominance. Response of individual species was correlated with their inherent radiosensitivities as predicted from variations in interphase chromosome volume. Within the rye crop, the radiosensitivity of agronomic yield components increased with proximity to seed maturation. Rye seed production was twice as radiosensitive as shoot production. (auth)

5477 CORRELATIVE INHIBITION OF ROOT EMERGENCE IN THE GAMMA IRRADIATED COLEUS LEAF. II. ABSCOPAL INCREASE OF RIBONUCLEASE ACTIVITY. Gordon, S. A.; Buess, E. M. (Argonne National Lab., IL). Radiat. Bot.; 12: No. 5, 361-4(Oct 1972).

Gamma irradiation of the lamina of the Coleus leaf was shown to raise the ribonuclease activity of the shielded petiole base within one-half day after exposure. The fall in RNA level in the petiole base was attributed to this abscopal response. Irradiation of the lamina did not change the lability of petiolar RNA to enzymatic hydrolysis. Post-irradiation exposure to cycloheximide or Actinomycin D prevented the activation of the petiolar ribonuclease. (auth)

5478 WHEAT PHYLOGENESIS. Meliya, N. S. (Inst. of Botany, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 68: No. 2, 417-20(Nov 1972). (In Russian).

Effects of x radiation on acid phosphatase activity in wheat were investigated in relation to genetic factors. On the basis of the acid phosphatase pattern data, it was possible to assume the presence of genes controlling certain factors. The blocking or unblocking of these factors depended on different levels of isoenzyme fractions of certain enzyme systems. (auth)

5479 GAMMA IRRADIATION AND POLLEN CULTIVAR INFLUENCE ON POLYEMBRYONY OF SATSUMA (CITRUS UNSHIU MARC). Spiegel-Roy, P.; Teich, A. H.; Kochba, J. (Agricultural Research Organization, Bet Dagan, Israel). Radiat. Bot.; 12: No. 5, 365-7(Oct 1972).

Seed of the mandarin orange cv "Satsuma", obtained by controlled pollination with two other cultivars, was irradiated from a ^{60}Co gamma-ray source. Pollen cultivar influenced germination rate and percentage and frequency of polyembryonic seed. Irradiation with 4 KR and larger doses delayed germination and reduced the number of germinated polyembryonic seed. Exposures low enough not to reduce germination percent, nevertheless, delayed germination. With increasing radiation exposure, the first seeds to suffer were those with the most embryos. Germination rate of seed with one or two embryos was stimulated with radiation levels up to 4 KR. Monoembryonic seed tolerated higher radiation exposures than polyembryonic seed, both in germination rate and percent. No serious damage to monoembryonic seed was observed with as much as 10 KR, and with one pollen, cultivar (clementine) doses up to 10 KR slightly increased germination percentage. (auth)

Radiation Effects on Animals

5480 STUDIES ON RADIATION EFFECTS. Hiyama, Yoshio (ed.). Tokyo; Tokyo Daigaku Shuppankai (1971). vp. (In Japanese).

Separate abstracts were prepared for the 7 chapters in the book. (E.R.B.)

For abstracts of individual chapters see: 5224, 5244, 5290, 5497–5499, and 5540.

Man

Refer also to abstracts 5333, 6774, and 6778.

5481 (AD–743005) RELATIONSHIPS BETWEEN DOSIMETER RESPONSE AND ABSORBED DOSE FOR 0.66-MeV GAMMA RAYS AND FOR 2.95-MeV NEUTRONS. Clifford, C. E.; Facey, R. A. (Defence Research Establishment, Ottawa (Ontario)). Mar 1972. 11p. (DREO-TN–72-12). NTIS.

The dose at sites in the interior and on the surface of a human phantom was measured for broad-beam exposure to 0.66-MeV gamma rays and to 2.95-MeV neutrons. Measurements were made for a range of angles of radiation incidence. A comparison is presented between the surface dose at possible dosimeter locations on the chest, abdomen and groin and the corresponding absorbed dose to the bone-marrow system and to the abdomen. Unless the geometry of exposure is accurately known, it is shown that a chest dosimeter is a poor indicator of the absorbed dose. A dosimeter worn on the groin would be significantly better for both neutrons and gamma rays for a wide range of exposure geometries. (auth)

5482 (BRH/DMRE–73-1) REDUCTION OF RADIATION DOSE IN DIAGNOSTIC X-RAY PROCEDURES. Proceedings of a Symposium held in Houston, Texas, July 8, 1971. (American Association of Physicists in Medicine. Bureau of Radiological Health, Rockville, Md. Div. of Medical Radiation Exposure). Sep 1972. 282p. (CONF-710726).

These proceedings are published to provide a source of information for users of equipment, radiological physicists, health physicists, equipment manufacturers, and others concerned with preparing and implementing radiation safety practices or guides for design and operation of medical diagnostic x ray facilities. The following topics are included in the proceedings: biological effects of small doses of radiation; population exposure to x rays; gonadal dose in private office diagnostic radiography; physical problems of dose reduction; medical problems of dose reduction; methods of dose reduction in diagnostic x-ray procedures; role of the radiology technologist in dose reduction; control by means of equipment standards; impact of NCRP recommendations and the role of the medical physicist in dose reduction; sensitometric quality control for automated film processors in radiography departments; simultaneous radiation dosimetry during routine fluoroscopic procedures in diagnostic radiography; and dose reduction in diagnostic radiography by electronic image storage techniques. (E.R.B.)

5483 (EUR-4800(Vols.1 and 2), pp 891-907) HAZARD POTENTIAL OF RADIOACTIVE WASTE. Gera, Ferruccio (CNEN, Rome); Jacobs, D. G. May 1972. (In Italian).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

In order to permit an estimate of the potential global risk to mankind from the presence in the environment of radionuclides accumulated by an expanding nuclear power economy, we introduce the potential hazard index (PHI) defined as: $(PHI)_i = f[P_i, Q_i(MPI)_i]$ where Q_i is the total activity of nuclide i, $(MPI)_i$ is the maximum permissible annual intake of nuclide i, and P_i is the probability that radionuclide i will reach man. The probability of nuclides, originally present in radioactive waste, reaching man is difficult to evaluate a priori. It is dependent upon waste management practices, upon the behavior of the particular radionuclide in environmental transfer processes, and upon the time available for the exposure to occur. It seems unlikely that we can significantly alter environmental transfer processes. Thus, the primary means for reducing the hazard potential is by selecting a waste management scheme that minimizes the probability of radionuclides entering the biosphere. In many cases, P cannot be assessed with an adequate degree of confidence because of the lack of necessary quantitative information about environmental transfer processes and about the reliability of the long-term containment of radioactive wastes. However, some situations are reviewed for which possible ranges of P can be estimated. (auth)

5484 RHABDOMYOSARCOMA FOLLOWING X-RAY THERAPY OF A BREAST CARCINOMA. Ferracini, R.; Bazzocchi, F. (Univ., Bologna). Strahlentherapie; 144: No. 2, 181-5(Aug 1972).

The first case in the literature of a rhabdomyosarcoma occurring after radiation treatment for carcinoma of the breast is described. A causal correlation between the origin of the sarcoma and the preceding irradiation must be assumed. (auth)

5485 CLINICAL EXPERIENCE WITH THE NEW ANTI-EMETIC IMICLOPACIN. Seifert, J.; Fiebach, O. (Ruhr Univ., Bochum, Ger.). Strahlentherapie; 144: No. 2, 216-21(Aug 1972). (In German).

In 267 patients the anti-emetic Imiclopazin (Ponsital® Asta, Brackwede) was clinically tested in the course of an ambulatory or stationary radiotherapy, as well as in case of incidents caused by application of contrast media. Severe side-effects were observed in 8 patients; 5 of them, however, received the preparation combined with a biliary contrast medium. Because of favourable results in the long-term therapy of radiation-sickness, Imiclopazin was administered when irradiating cerebral tumours or when applying irradiation series covering large abdominal areas. (auth)

5486 INFLUENCE OF IRRADIATION OF OOCYSTS ON VITALITY OF SPOROZOITS OF E. TENELLA. Marjankova, K.; Stejskal, J. (Univ. School of Veterinary Medicine, Brno). Acta Vet. (Brno); 41: No. 2, 191-5(Jun 1972).

Sporulated oocysts were irradiated by the dose of 20,000 R. Within 24, 48, and 72 hrs after irradiation, sporocysts and sporozoits were obtained from both irradiated and nonirradiated oocysts of the same origin by using a routine method. The numbers of sporocysts obtained from the irradiated oocysts were higher than those from the nonirradiated ones, while the numbers of sporozoits from the irradiated oocysts were smaller than those from the nonirradiated ones. The sporozoits obtained from the oocysts 24 hrs after irradiation formed a complete endogenous cycle on the CAM of the chicken embryos. The infection intensity, however, was lower in comparison with that produced by the same number of sporozoits from the nonirradiated oocysts. Thus irradiation did not break the endogenous cycle of Eimeria tenella, but it only reduced the number of sporozoits with invasive power. (auth)

5487 PROBLEMS OF PERSONNEL DOSIMETRY AND MAXIMUM PERMISSIBLE EXPOSURE FOR FIRE-BRIGADE MEN IN ACTION. Wachsmann, F. VFDR (Ver. Foerder. Deut. Brandschutzes) Z.; 20: No. 2, 45-50(1971). (In German).

Following an introduction on radiation exposure and possible radiation injuries, an outline is given of the provisions of the Federal Republic of Germany governing the employment of fire-brigade men in cases involving the danger of a radiation exposure. According to these provisions, the dose received by fire-brigade men in action should not exceed 3 rem. In very urgent cases, a fire-brigade man may receive a dose of 12.5 rem once in his life. During life-saving actions, this maximum permissible dose may even amount to 25 rem. Nevertheless, there may be cases where a fire-brigade man will run the risk of receiving doses between 50 and 100 rem, should the need arise to prevent serious personal or material damage, in order to prevent all possibility of being reproached with having failed to do their duty. The fire-brigade men are, of course, provided with appropriate dosemeters. (GF)

5488 EFFECT OF FRACTIONATED RADIOTHERAPY ON SALIVARY GLAND FUNCTION. Eneroth, C. M.; Henriksson, C. O.; Jakobsson, P. A. (Karolinska Sjukhuset, Stockholm). Cancer; 30: No. 5, 1147-53(Nov 1972).

The effect of fractionated radiotherapy on salivary gland function was studied by sialography and sialometry of parotid gland in four patients irradiated with 4000 or 6400 rads for malignant tumors of the head and neck region. Sialography was performed at the beginning and end of the irradiation period and 8 months later. By sialometry, the salivary secretion rate was determined after each irradiation treatment (a daily dose of 200 rads) during the whole treatment period and again 8 months later. The size of the glands was found to be unchanged at the end of the irradiation period despite the pronounced disturbance of the salivary secretion rate at this time. Thus it can be stated that the size of irradiated parotid glands is not a criterion of their function as in the case of normal glands. It was not possible to identify a critical dose level giving a pathologically low salivary secretion. Even after high doses in fractionated radiotherapy, a recovery of the parotid gland function has been found. Parotid glands on the non-tumor side were irradiated with a dose of between 400 and 600 rads, and these small doses did not cause a reduction of salivary secretion rate below normal variation. (auth)

5489 RADIATION AND LEUKEMIA. Maisin, J.; Dunjic, A. (Univ. Saint-Raphaeel, Louvian, Belg.). Bruxelles-Med.; 50: No. 3, 157-74(Mar 1970). (In French).

The leukemogenic effects of radiation have been under long study both in men and in laboratory animals. A bibliographic review is made of the more significant conclusions reached. The incidence of leukemia in those irradiated at Hiroshima and Nagasaki, in infants irradiated for therapeutic purposes, and irradiated adults is discussed. On laboratory animals, the leukemogenic effect of whole-body irradiation, whole-body irradiation in fractionated doses, and partial irradiation was studied. The effects of hormones on the leukemogenic effect of radiation were considered. Interpretations of the leukemogenic effect of radiation derived from the experimental data were summarized. (J.S.R.)

5490 BRACHIAL PLEXUS INJURY FOLLOWING X-RAY IRRADIATION. Lebkowski, J.; Lewko, J.; Kopec, J. Neurol. Neurochir. Pol.; 6: No. 1, 175-6(1972). (In Polish).

A case of postirradiation injury to the brachial plexus following x-ray therapy after radical mastectomy for carcinoma is described. It is stressed that in reaching the decision of radical surgical treatment of mammary tumors followed by radiotherapy, the possibility of injury to the brachial plexus should be taken into consideration. This problem is of considerable importance since no treatment of this condition is practically available. (auth)

5491 EFFECT OF A POSTOPERATIVE HIGH-DOSE TELECOBALT IRRADIATION UPON THE URETER. Schumann, J. W.; Frischbier, H.-J. (Univ., Hamburg). Strahlentherapie; 144: No. 2, 148-55(Aug 1972). (In German).

In 84 female patients, exposed to a high-dose telecobalt irradiation with 6000 rd after operation of a genital carcinoma, control check-ups by isotope nephrography after 1.5 to 6 years proved that a radiogenic obstruction of the urine flow was present in three cases only (i.e., 3.5 p.c.). Therefore, the usual complication rate on the ureter after irradiations was not augmented. This observation refutes former observations according to which the dose should not exceed 3000 up to 3300 rd on the pelvic wall. (auth)

5492 RADIOTHERAPY OF BLADDER CARCINOMA: STANDING-FIELD ISODOSES AT ^{60}Co-TELETHERAPY. Ahlmeyer, A. Muenster, Ger.; Muenster Univ. (1971). 58p. (In German).

Thesis.

A new plastic phantom in the shape of a human skeleton was irradiated by the Gammatron I. The applied doses were measured by means of a Pychlau condiometer and membrane-type condensation chambers within the phantom layers. The spatial dose distribution is graphically represented as isodoses. (GF)

5493 PENDULUM IRRADIATION BY FAST ELECTRONS OF A 42 MeV BETATRON. Klein, H. D. Cologne; Cologne Univ. (1971). 69p. (In German).

Thesis.

The influence of electron energy, pendulum angle, pendulum depth, and field width on the dose distribution for the therapy of rectum carcinomas was systematically investigated using condenser-ion chambers in an Alderson phantom. Optimum irradiation conditions are: energy 32.5 to 35 MeV, according to the cross-diameter of the patient; pendulum angle ±75°C; depth of pendulum axis 12 cm; field width 12 cm; field length 14 to 18 cm according to the tumor extension. (GF)

5494 EMERGENT DOSE ESTIMATION OF NON-OCCUPATIONAL PERSONS ACCIDENTALLY EXPOSED TO ^{192}Ir GAMMA RAYS. Hashizume, T.; Kato, Y.; Nakajima, T.; Yamaguchi, H.; Fujimoto, K. (National Inst. of Radiological Sciences, Chiba, Japan). Health Phys.; 23: No. 6, 855-7(Dec 1972).

Six non-occupational people, not carrying personnel monitoring dosimeters, were exposed accidentally and intermittently to an industrial radiography ^{192}Ir source over a period of six days. Three of the people had a leukocyte count of about 3000 c/mm^3 on admission to hospital indicating that a high exposure had taken place. To estimate the dose that was received so that medical treatment could be started, rubies from the watches worn by three of the patients were used as thermoluminescent dosimeters. With a knowledge of the length of exposure for each patient and the exposure received from the investigation of the rubies, the average distance of each patient from the source was derived and thus a mean absorbed dose in the whole body was estimated. (UK)

5495 LEUKEMIA FROM LOW-LEVEL RADIATION. IDENTIFICATION OF SUSCEPTIBLE CHILDREN. Bross, Irwin D. J.; Natarajan, Nachimuthu (Roswell Park Memorial Inst., Buffalo). New Engl. J. Med.; 287: No. 3, 107-10(20 Jul 1972).

Current procedures for setting safe levels for exposure to low-level radiation are based on the assumption that the population exposed to the risk of leukemia (or other disease) is homogeneous. Analysis of data on 295 children with leukemia and 813 random-sample controls (Tri-State Survey) demonstrates that this assumption is wrong. There are at least two subgroups (susceptible and nonsusceptible) in the population. Exposure to low-level radiation such as diagnostic x-rays during pregnancy produces little increase in risk of leukemia in the nonsusceptible subseries. However, the same radiation exposure can increase relative risk almost 10 times in subseries with a relatively high proportion of susceptible subjects, who can be identified on a probability basis by information in the health record of mother and child. Preliminary analyses suggest that nonsusceptible children are unaffected by radiation doses of magnitudes greater than those that affect the susceptible group. (auth)

5496 RADIATSIONNAYA BEZOPASNOST'. CHAST' I. KRITERII RADIATSIONNOI BEZOPASNOSTI. (Radiation Safety. Part I. Criteria of Radiation Safety). Golikov, B. Ya.; Moiseev, A. A. Moscow; Ministerstvo Zdravookhraneniya SSSR, Tsentral'nyi Ordena Lenina Institut Usovershenstvovaniya Vrachei (1971). 12p.

Terminology of radiation damage to the human body is briefly but quantitatively treated, including such expressions as the genetically significant dose and chronic radiation syndrome. Radiation doses characteristic of personnel that utilize x rays and other radiation sources are systematically tabulated, with data on injuries to the head, torso, bone marrow, skin, and hands. (K.S.W.)

5497 RADIATION DOSES AND DOSIMETRY. Tajima, E. (Rikkyo Univ., Tokyo). pp 1-25 of Studies on Radiation Effects. /Hiyama, Yoshio (ed.). Tokyo; Tokyo Daigaku Shuppankai (1971). (In Japanese).

The basic concepts of radiation dosimetry are discussed. Since the introduction of the new concept of radiation absorbing energy and radiation field into radiation dosimetry, theoretical studies on distribution of linear energy transfer (LET) in absorbing energy and the new dicipline of microdosimetry have been developed during the past 15 yrs. The concept of microdosimetry was introduced for the purpose of clarifying the effect of radiation quality on radiation biology in terms of unified measurement of physics. For application of the target theory based on the concept of microdosimetry, the knowledge of activation products should be necessary. Further studies should be carried out in this respect. Doses of irradiation in the environment are given, citing reference sources. Radioactivity in the environment originates either from natural radionuclides or from interaction of cosmic ray with the earth's atmosphere. For instance, an individual receives in soft tissues about 50 mrem per year from radioactive substances of cosmic origin, according to the report of the United Nations Scientific Committee on the Effect of Atomic Radiation. Traces of fission and activation product radionuclides can be detected in the air, water, crust of the earth, and in some cases in human food and tissues. Morever, the environmental contamination due to the testing of nuclear weapons has become a significant problem. Dosimetry, using the threshold detector, scintillation counters, and various other methods, has improved accordingly. (Japan)

5498 GENETIC RADIATION EFFECTS. Tanaka, N. (Tokyo Univ.). pp 291-361 of Studies on Radiation Effects. /Hiyama, Yoshio (ed.). Tokyo; Tokyo Daigaku Shuppankai (1971). (In Japanese).

This paper is a collection of reports of the present development of basic studies on (1) mutation induced by irradiation, (2) radiosensitivity, and (3) chromosomal aberrations induced by irradiation. Radiation doses, RBE and radiation quality, mutagenesis occurred by transmutation of radionucleides in the period of fission, and repair function of premutational damages were discussed regarding mutation frequency induced by ionizing radiation. Differential radiosensitivity according to species, polyploidy and growth stages of germ cells, and periods of cell cycle were described in relation to differential factors in manifestation of mutations. Chromosome aberrations that occurred after irradiation during the periods of S, G_2, and M were discussed in terms of chromosomal breakages in particular, mechanism of DNA synthesis and replication, chromatid break, isochromosome break, fractional and whole mutations occurred due to the stages of cell colonies, and the rate of mutation dependence on LET. Further discussions were carried out on chromosomal aberration, genetic diseases, congenital malformations, death of fetus, shortening of life span, and genetic damages as a whole specifically in men who are exposed to irradiation. Improvement of basic research, development of research methods and collection of findings and statistical materials on genetic radiation effects on men should be more enforced for future protection of the mass human population as a whole from genetic radiation damages. (Japan)

5499 PROTECTION AND TREATMENT OF RADIATION INJURIES IN HUMAN BODIES. Miyakawa, T. (Tokyo Univ.). pp 363-454 of Studies on Radiation Effects. /Hiyama, Yoshio (ed.). Tokyo; Tokyo Daigaku Shuppankai (1971). (In Japanese).

The present work contains a collection of articles on (1) the effects of radiation on human body, (2) chemical protection against injuries due to radiation exposure, and (3) their therapeutic treatment. In relation to radiation effects on man, only the studies and surveys of any significance are selected for discussion, thus providing suggestion for future investigation. The topics discussed include radiation effects on hematopoietic system and the central nervous systems; induction of malignant diseases such as leukemia, cancer of the neck, thyroid, skin and bones as well as carcinogenesis of Thorotrast; radiation injuries observed in the patients in Hiroshima; those in Nagasaki with special reference to leukemia; and the clinical course of patients who received radiation following the nuclear experiment at the Bikini. Each topic discussed also early radiation effects and delayed radiation effects in relation to radiosensitivity of cellular or regional level. Chemical protection of radiation is discussed in terms of radioprotective agents and the chemical substances that promote recovery from injuries. The mechanism of radioprotective agents is briefly described with radical scavenger hypothesis, mixed disulfide hypothesis, hypoxia hypothesis, energy transfer hypothesis, repair of damaged molecules hypothesis, and biochemical shock hypothesis. Radioprotective agents discussed include thiols, amines, and adenosine derivatives. Chemical agents for accelerating recovery from radiation injuries are nucleic acids, endotoxins, and various vitamins and hormones. The treatment of accidental exposure to radiation, both external and internal, is briefly discussed. (Japan)

5500 CALCULATIONS FOR PRODUCING DESIRED DEPTH-DOSE DISTRIBUTIONS USING NEGATIVELY CHARGED PIONS. Armstrong, T. W.; Alsmiller, R. G. Jr.; Chandler, K. C. (Oak

Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 715-16(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5501 CHROMOSOME BREAKAGE AS A DOSIMETER. Jackson, J. F.; Clement, E. G.; North, E. R.; Woosley, P. (Univ. of Mississippi, Jackson). Lancet; 2: No. 7783.920(28 Oct 1972).

The statistical difficulties in obtaining clinically interpretable results are briefly discussed in relation to chromosome analysis used as a dosimeter in man. Peripheral-blood leukocytes were scored for chromosome breakage in 202 patients, five of these having been exposed to L.S.D. or radiation. One difficulty shown by the results was that of establishing normal population aberration-rates in view of variation between laboratories. Another was achieving adequate sample sizes for evaluation of individual analysis. (UK)

5502 LATE EVALUATION OF URINARY TRACT IN PATIENTS WITH GRADE I AND II CERVICAL CARCINOMA TREATED WITH RADIOTHERAPY. Wozniakowska, Z.; Marquardt, M. (Inst. of Oncology, Gliwice, Poland). Pol. Przegl. Radiol. Med. Nukl.; 36: No. 4, 527-32(1972). (In Polish).

Radiotherapy of cervical carcinoma exposes the bladder, lower parts of ureters, and rectum to a large dose of radiation and late radiation-induced changes are frequent. Changes following radiation exposure were found in the bladder mucosa in 74% of cases, changes in lower parts of ureters in 13%. Periodic urological examinations are indispensable in treatment of cervical carcinoma. (auth)

5503 RESULTS OF RADIOTHERAPY IN SKIN CANCER OF THE EYELID. Swierzowa, Janina; Kujawska, Janina; Mazur-Sokolowska, Janina. Pol. Przegl. Radiol. Med. Nukl.; 36: No. 4, 521-6(1972). (In Polish).

In a group of 270 patients with skin cancer of the eyelids treated at the Institute of Oncology in Krakow from 1951 to 1960, the five year survival rate was 79%. Attention is called to the functional state of the eye in the group of 195 patients with cancer followed-up for 5 years. In 68% of cases the functional state of the eye was regarded as good; in 27% radiation-induced lesions of the protective apparatus of the eye were found; in 5% of cases visual impairment or loss of vision occurred. The causes of development of severe radiation-induced ocular lesions are discussed. (auth)

5504 POSSIBLE MECHANISM OF THERAPEUTIC ACTION OF IONIZING RADIATION. Andronikashvili, E. L. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 68: No. 2, 313-16(Nov 1972). (In Russian).

A possible mechanism of therapeutic action of ionizing radiation has been considered. It is shown, in particular, that slowing down of cell division occurs as a result of ionizing radiation action; that is to say, suppression of DNA reduplication and RNA transcription take place. (auth)

5505 RELATION BETWEEN β DOSE IN THE SKIN AND γ EXPOSURE FROM SURFACES CONTAMINATED WITH AGED FISSION PRODUCTS. Clarke, R. H.; Beynon, S. M. (Central Electricity Generating Board, Berkeley, Eng.). Health Phys.; 23: No. 6, 807-15(Dec 1972).

Calculations were performed that relate the β-dose to human skin in contact with surfaces uniformly contaminated by fission products to the γ-exposure monitored by an instrument away from the surface. The β- and γ-spectra for fuels of varying burn-up and enrichment were predicted, as a function of cooling time after irradiation. These spectra were used as sources for calculating doses and exposures from discs of contamination with sizes ranging from single particles up to areas of several square meters. The ratio of the skin β-dose to the measured γ-exposure is shown to be almost independent of irradiation and enrichment for Magnox and CAGR fuels while it is strongly dependent upon cooling time and the depth at which the radiosensitive volume of the skin is assumed to exist. (auth)

5506 EVALUATION OF INFLUENCES FROM LOW DOSE RADIATION EXPOSURE. Kitabatake, Takashi (Niigata Univ., Japan). Rinsho Hoshasen; 17: No. 2, 115-21(Feb 1972). (In Japanese).

Recently, ionizing radiation exposure of the Japanese has become much more frequent, while radiation injury by high dose exposure has been reduced. That is to say, the exposure at present is low dose exposure of a large population, which takes place of the high dose exposure of a small population in the past. The injury by the low dose exposure is usually difficult to evaluate individually, but the radiation epidemiological method that considers the injury as statistical injury of groups is effective. Induction risk of leukemia by the low dose exposure is shown by the number of patient per million population/year/unit dose. ICRP defines classification of the risk: for example, class 5 is defined as the risk with 1×10^{-5} to 10×10^{-5}, and class 3 as 1×10^{-3} to 10×10^{-3}. The risk of leukemia is frequent in the irradiated group statistically. It must be considered that there is much risk to bring about genetic abnormality of embryo at the first stage of pregnancy, and to cause malignant tumor after delivery. (auth)

5507 RADIATION-INDUCED CANCER. Miller, R. W. (National Cancer Inst., Bethesda, Md.). J. Nat. Cancer Inst.; 49: No. 5, 1221-7(Nov 1972).

A review of the literature on cancer induction in man following exposure to ionizing radiation is presented. The development of leukemia in atomic bomb survivors and patients exposed to radiotherapy is reviewed and the lowest leukemogenic dose is discussed. In utero and preconception induction of cancer are reviewed with emphasis on linear dose-response relationship. Susceptibility to cancer after childhood irradiation and radioinduced neoplasms of the thyroid, lungs, breast, and bones are reviewed. (54 references). (H.L.W.)

5508 BACTERIAL FLORA OF IRRADIATED SKIN IN PATIENTS UNDERGOING RADIOTHERAPY FOR MALIGNANT NEOPLASMS. Ciencialowa, M. Pol. Tyg. Lek.; 27: No. 20, 733-6(15 May 1972). (In Polish).

In 60 patients undergoing radiotherapy for malignant neoplasms of various organs, bacteriological examinations were carried out to determine the bacterial flora of the skin in the irradiated fields. The state of bacterial flora was evaluated with respect to the kind and amount of bacterial colonies growing under aerobic conditions. It was demonstrated that the condition of bacterial flora of irradiated skin fields depends on the degree of reaction to radiation. Particularly in cases with strong oozing reactions the method used for obtaining live bacteria from the skin demonstrates that dynamics of development of staphylococci resistant to antibiotics may be used in treatment of radiation-induced skin changes. (auth)

Vertebrates

5509 (AD-742075) PERFORMANCE OF TRAINED BEAGLES AFTER SUPRALETHAL DOSES OF RADIATION. Chaput, R. L.; Kovacic, R. T.; Barron, E. L. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Feb 1972. 24p. (AFRRI-SR-72-1). NTIS.

Nine beagle dogs were trained by shock avoidance conditioning to work a discrimination problem cued by visual and auditory stimuli. The animals received 5200 to 17,600-rad midline tissue doses of pulsed mixed gamma-neutron radiation, and their post-irradiation performance was evaluated. During the first 60 min after irradiation, random, brief periods of performance decrement frequently occurred. Dogs that received less than 10,000 rads performed at or near preirradiation levels several days until they became permanently incapacitated shortly before death. After doses of 10,000 rads or more, most dogs performed satisfactorily for only a few min to hrs. Their condition then worsened precipitously and the dogs died shortly thereafter. (auth)

5510 (AD-742076) NEUTRON EFFECTIVENESS FOR CAUSING INCAPACITATION IN MONKEYS. Thorp, J. W.; Young, R. W. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Apr 1972. Contract DNA-NWER-XAXM. 17p. (AFRRI-SR-72-5). NTIS.

Fifty-eight male monkeys (Macaca mulatta) were trained by shock avoidance conditioning to work a simultaneous visual discrimination problem. Trained subjects were irradiated in either a nuclear reactor-produced neutron field (incident neutron to gamma ray ratio of about 10) or a similarly produced gamma ray field (incident neutron to gamma ray ratio of about 0.1). In all exposures the midbrain dose rate was about 2000 rads/min. The midbrain dose most likely to cause early transient incapacitation (ETI) in 50% of the irradiated subjects was determined. The signs and symptoms of ETI were the same whether the monkey received gamma or neutron radiations. (auth)

5511 (AD-743030) SPONTANEOUS AND EXTERNAL RADIATION-RELATED TUMORS IN NONHUMAN PRIMATES. A SURVEY. Kirk, J. H. (School of Aerospace Medicine, Brooks AFB, Tex.). Apr 1972. 28p. (SAM-TR-72-7). NTIS.

A survey was made of the occurrence of spontaneous and external radiation-related tumors in primates. More than 30 tumors related to irradiation exposure and more than 270 spontaneous tumors were found. The 137 literature references concerning these tumors are listed in two comprehensive tables,

according to the location and type of tumor, as well as to the species, sex, and age of the respective primates. (auth)

5512 (AD-743062) EFFECT OF INCREASING DOSES OF IONIZING RADIATION ON LIVER ENZYMES INVOLVED IN FATTY ACID SYNTHESIS. McHale, C. G.; Catravas, G. N. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Mar 1972. 20p. (AFRRI-SR-72-2). NTIS.

The effect of increasing doses of x rays and of mixed neutron-gamma radiation on the fatty acid synthesizing liver enzyme system in rats was investigated. It was found that the activity of this enzyme system first increased with radiation dose and then decreased in rats exposed to either x rays or mixed neutron-gamma radiation. Acetyl CoA carboxylase activity was found to be more sensitive to mixed neutron-gamma radiation (decreased) than to x rays, whereas fatty acid synthetase appeared to be more sensitive to x rays (increased) than to mixed neutron-gamma radiation. (auth)

5513 INVESTIGATIONS ON POST-RADIATION HYDROLYTIC ACTIVITY OF ISOLATED PERFUSED LIVER. PART II. INVESTIGATIONS ON THE MECHANISM OF POST-RADIATION INCREASE OF β-GLUCURONIDASE ACTIVITY. Kocmierska-Grodzka, D. (Medical Academy, Bialystok, Poland). Strahlentherapie; 144: No. 1, 121-5(Jul 1972).

Work was performed in the aim to clarify the cause of greater β-glucuronidase activity in lysosome-mitochondrial fraction and perfusate of irradiated perfused livers in comparison with control. Liver tissue samples from whole-body 800 R x-irradiated perfused 24-hr following irradiation were examined. For this reason the stabilizing agent against lysosomal membranes (dextran) into the perfusate medium was introduced. Under the influence of dextran significant decrease of β-glucuronidase activity in the perfusate and lysosome-mitochondrial fraction was stated. Because dextran does not decrease free hydrolytic activity of β-glucuronidase the obtained results are interpreted as the stabilizing effect of this polyhydroxyl compound against biological barriers of rat cell. Post-irradiation increase of β-glucuronidase activity in perfused liver seems to be caused by easier release of enzyme through damaged lysosomal membrane. (auth)

5514 RADIOPROTECTIVE EFFECT OF IMMUNIZATION BY PHYTOUREASE: STUDY WITH GERM-FREE MICE. Hlavaty, V.; Grezes-Higounet, F.; Salomon, J. C. (Charles Univ., Prague). Strahlentherapie; 144: No. 1, 117-20(Jul 1972).

Conventional and germ-free mice were immunized with phytourease and irradiated with a lethal dose of x-ray (800 or 1000 R). Phytourease has a clear radioprotective effect on conventional mice but was inefficient on germ-free mice, in spite of an equivalent synthesis of antibodies in the two groups of animals. The radioprotective effect of phytourease seems related to an inhibition of the intestinal splitting of urea, by anti-urease antibodies which neutralize the urease made by the bacterial flora of conventional mice. In germ-free mice there is no intestinal urease, the inefficiency of urease immunization gives an argument in favor of this hypothesis. (auth)

5515 DOSE AND PHASE DEPENDENCY OF THE RADIOPROTECTIVE EFFECT OF CYSTAMINE DURING PRENATAL DEVELOPMENT OF THE MOUSE. Konermann, G. (Univ., Freiburg i. B.). Strahlentherapie; 144: No. 1, 96-116(Jul 1972). (In German).

Pregnant mice were irradiated on the 3rd, 6th, 9th, 12th, or 15th day p. c. by a single dose of x-rays, which ranged from the lowest effective doses up to lethal insults for each developmental stage. The experimental groups of either unprotected or injected animals (200 mg cystamine per kg bodyweight, 8 min before irradiation) were compared regarding the frequency of morphological normal, malformed, and dead fetus as well as the frequency of embryonic deaths in percent of the total number of implantation sites visible after uterine dissection at the 19th day p. c. A special evaluation was made in view to the fetal and placental weights and to the incidence of the different topographical and skeletal malformations. Marked differences in the relative protective effect of cystamine will be demonstrated for the different levels of the irradiation doses and for the various developmental stages as well. The protective effect of cystamine for the younger embryos must be emphasized because of their higher radiosensitivity on the one hand and their greater ability of regeneration on the other hand. The pronounced teratogenic irradiation effects during organogenesis can also be reduced by cystamine, but to a different extent for the special forms of malformations. At sublethal doses unprotected embryos in organogenesis will die during the late embryonic or early fetal stages. However, protected embryos often grow up as malformed fetus. (auth)

5516 INFLUENCE OF A BALANCED SYNTHETIC DIET ON THE IRRADIATION REACTION OF RATS. Kuenkel, H. P.; Zywietz, F.; Brueckner, V.; Mihajlovic, L. (Univ., Hamburg). Strahlentherapie; 144: No. 1, 77-86(Jul 1972). (In German).

The influence of a balanced synthetic diet (Vivonex 100) on the irradiation syndrome was studied on 600 rats, after whole body irradiation with a semilethal dose. At first, tolerance and general effects on the rat were investigated. Although this diet is not specific for rats, no disturbance of the vital functions was noted in juvenile rats, except a slight increase in weight. Under feeding with Vivonex 100 the intestinal contents were reduced down to 15 p.c. of the initial weight. At the same time, the bacterial flora (aerobic bacteria and lactic acid bacilli) in the small and large intestine quantitatively as well as qualitatively decreased. The quotient of aerobes to lactobacilli in the course of the Vivonex 100 treatment shifted in favor of the aerobic bacteria. The survival rate of the irradiated rats depended on the timing of the application. Those animals, fed with Vivonex 100 from the irradiation day on, had the lowest survival rate. The other animals, treated with Vivonex 100 before or before and after irradiation, had an unchanged survival rate in comparison to the controls. Therefore, a prophylactic or therapeutic application of Vivonex 100 does not seem to be successful in irradiation damage under the test conditions reported above. (auth)

5517 CHANGES IN THE ^{131}I-LABELLED HETEROLOGOUS ANTIGEN CONTENT OF CHICKEN ORGANS AFTER TOTAL BODY X-IRRADIATION. Krejci, J.; Hampl, J.; Prochazka, Z. (Veterinary Research Inst., Brno). Strahlentherapie; 144: No. 1, 70-6(Jul 1972).

A study was made on the effect of ionizing radiation upon the cumulation of heterologous antigen HSA – ^{131}I in the organs of chickens irradiated with 1200 R (i.e., with LD_{50}) and injected i.v. with antigen 30 min., 6 days or 14 days after irradiation. The amount of bound antigen was expressed in terms of index I (the ratio of activity per 1 g tissue to activity per 1 g blood). In control chickens, index I values began to rise on day 5 and reached a peak on day 9. The effect of irradiation was most marked in the group of chickens irradiated 6 days before antigen injection, with the birds showing a considerable decrease and delay in antigen cumulation in the organs. In chickens irradiated 30 min before antigen injection the decrease and delay in antigen cumulation were somewhat less marked. In chickens irradiated 2 weeks before antigen injection the onset of antigen cumulation was also delayed, but the antigen concentration was relatively increased. (auth)

5518 RETICULOENDOTHELIAL SYSTEM PHAGOCYTOSIS FOLLOWING QUANTIFIED COMBINED INJURIES. Schildt, B. E.; Grundfelt, M.-B. (Research Inst. of National Defence, Sundbyberg, Sweden). Strahlentherapie; 144: No. 1, 50-9(Jul 1972).

The phagocytic function was studied in mice subjected to quantified burn (B), mechanical injury (M) and whole-body x-irradiation inflicted in two grades of severity (LD_{10} and LD_S = sublethal) either as single injuries or in different combinations. The following combined injuries were studied: $B_{10} + R_S$, $B_S + R_{10}$, $M_{10} + R_S$, $M_S + R_{10}$, $B_{10} + M_S$, $B_S + M_{10}$ as well as those inflicted in the reverse order. The time interval between traumata was eight days when irradiation was the prior injury and one hour when burn or mechanical injury preceded. Phagocytosis was estimated by determining the disappearance rate of intravenously injected ^{51}Cr-labeled rabbit erythrocytes and expressed as the half-time value (T 1/2). All single injuries, except R_S and M_S, increased T 1/2 significantly compared to controls. The same was the case for all combined injuries, the increase here being additive, i.e., equalling the sum of the increase caused by each injury when inflicted alone as a control. The order of infliction was of little importance. The effect upon T 1/2 seemed to be correlated more to the severity than to the type of trauma. Most $LD_{10} + LD_S$ as well as $LD_S + LD_{10}$ injuries thus decreased the phagocytic capacity to a comparable degree irrespective of type of trauma included in the combinations. The decrease in phagocytic capacity was found to be correlated to the decrease in survival rate for most combinations. These findings indicate that the phagocytic capacity in combined injuries is decreased in proportion to the severity of the trauma components. They further indicate a qualitative relationship between phagocytic function and survival rate. (auth)

5519 MORTALITY RATE IN QUANTIFIED COMBINED INJURIES. Schildt, B. E. (Research Inst. of National Defence, Sundbyberg, Sweden). Strahlentherapie; 144: No. 1, 40-9(Jul 1972).

A study was made of the mortality rate and survival time in mice subjected to three types of standardized and quantified injuries in different combinations: burn (B), mechanical trauma (M), and x-irradiation (R), inflicted in two grades of severity (LD_{10} and LD_S = sublethal). The order of trauma infliction was varied for each combination as well as the time interval between traumata (0 to 30 days). In all, 79 combinations were studied.

All trauma combinations led to an additive or strongly synergistic increase in the death rate. R_{10} in various combinations with B_S or M_S raised the mortality rate to 95 to 100%, being 6 to 19 times the sum of the mortality in controls. Various combinations of R_S or B_{10} raised the number of deaths to 20% or four times the control value. In combinations of burn and trauma, the highest recorded death rate was 50% in $B_{10} + M_S$, 30% in $M_S + B_{10}$ and 55% in $B_S + M_{10}$ as well as in $M_{10} + B_S$, representing four to ten times that in controls. Variations of the time interval between irradiation and a second injury (B or M) led to maximum mortality at eight to twelve days. Following B or M, the susceptibility to irradiation reached a peak at day five. In combinations of burn and mechanical trauma, this interval was zero to three days. Survival time was markedly shortened in most combinations, death occurring in a great number within 24 hours after the second trauma. The findings indicate that a strong synergistic effect on the mortality rate is a general phenomenon in combined injuries, irradiation not being an obligatory component. (auth)

5520 ERYTHROPOIETIC RADIOSENSITIVITY OF THE RAT DURING ALTITUDE ACCLIMATIZATION. Gaugl, J. F. (Univ. of California, Berkeley). Amer. J. Physiol.; 221: 1763-7(Dec 1971).

The effect of a sublethal dose (300 R) of x radiation upon the erythropoietic system of the rat, during 60-day acclimatization to moderate hypoxia (3,800 m altitude), was studied. Past work has shown that hypoxic animals are damaged less by radiation than animals irradiated in a normal environment; therefore, it was postulated that if, after acclimatization to hypoxia the bone marrow oxygen tension returns to sea-level values, these animals should suffer radiation damage equivalent to animals at sea level. The principal parameters followed were the rate of depletion of injected ^{59}Fe from the plasma of chronically catheterized rats, and its subsequent reappearance in the circulating erythrocytes. After 20 days of acclimatization, both parameters for altitude-irradiated animals returned to the values of animals irradiated at sea level, previously having reflected increased erythropoiesis. In altitude nonirradiated animals the parameters indicated erythropoietic stimulation persisting up to 45 days acclimatization. The protective effect of the hypoxia on the stem cells vanished during acclimatization, presumably as cellular oxygen tension rose. (auth)

5521 COMPARATIVE RADIOSENSITIVITIES OF MALE RATS AND MICE. Gilliavod, N.; Leonard, A. (CEN, Mol, Belgium). Compt. Rend. Soc. Biol.; 166: No. 1, 209-11(15 Sep 1972). (In French).

Groups of 25 male rats and 50 male mice were irradiated with increasing doses of x radiation in order to establish whether or not a correlation existed between the 50/30 days LD and the radiosensitivity of their testes. Five members of each species were sacrificed after 7, 14, 21, 28, 35, 50, and 100 days together with 5 corresponding reference animals. Histological examinations of the testes were carried out and the frequency of appearance of the different reproductive cells was established. (auth)

5522 DOSE MEASUREMENT IN ANIMAL EXPERIMENTS. I. DOSE DISTRIBUTION IN ^{60}Co IRRADIATED RABBITS, GUINEA-PIGS, AND RATS. Novotny, J.; Mika, J.; Otoupal, P.; Hrusovsky, J. (Faculty of Nuclear Science and Physical Engineering, Prague). Strahlentherapie; 144: No. 2, 222-6(Aug 1972).

The use of LiF thermoluminescence dosimeters for the absorbed dose measurement in animal experiments as well as calibration procedure is discussed. Absorbed doses in several points of ^{60}Co γ irradiated animal cadaver of rabbits, guinea pigs and rats were measured using LiF TLD. The homogeneity of irradiation in measured animals was established as uniform according to ICRU classification. (auth)

5523 INFLUENCE OF NATURAL AND SYNTHETIC PROTEASE INHIBITORS ON RAT AND MOUSE LIVER CATHEPTIC ACTIVITY. Kocmierska-Grodzka, D.; Goutier, R. (SCK-CEN, Mol, Belg.). Strahlentherapie; 144: No. 2, 245-50(Aug 1972).

We investigated the anticatheptic (anti-naphthylamidase) activity of E-aminocaproic acid (EACA) on the crude lysosomal fraction of control and irradiated rat livers and on the aqueous extracts of mice and rat livers. It was observed that EACA is most active as an anticatheptic agent when used at a concentration of 0.4 M. The efficiency of this drug was similar in fractions obtained from control and irradiated rats. Combined administration of EACA with subactive concentrations of haptoglobin increases the anticatheptic activity of the latter glycoprotein. The possible mechanism of the observed interaction between the agents is discussed. (auth)

5524 ALTERATION OF THE POST-IRRADIATION DISTURBANCE OF HAEMOSTASIS BY MEANS OF ELLAGIC ACID. Klir, P.; Skala, E.; Pospisil, J.; Dienstbier, Z. (Charles Univ., Prague). Strahlentherapie; 144: No. 2, 234-41(Aug 1972).

Ellagic acid administered intravenously to irradiated dogs (500 R) in 5% buffered glucose (2×10^{-4}M) at a dose of 10 ml/kg significantly shortened the whole-blood clotting time in glass and silicone-coated tubes during the first 5 hours after administration. The activation of factor XII in the one-stage test was significantly increased. The platelet adhesiveness and the platelet count remained unchanged. When ellagic acid was administered at the same concentration and dose to whole-body irradiated rabbits (700 R) the bleeding time was significantly shortened. Six hours after the administration the effect of the compound began to disappear. (auth)

5525 INVESTIGATIONS ON THE CALCIUM METABOLISM OF BONES AFTER LOCAL IRRADIATION. XII. CORRELATION OF NUCLEAR MEDICAL AND MORPHOLOGICAL FINDINGS AFTER DIFFERENT RADIATION DOSES. Kolar, J.; Babicky, A.; Dorazilova, V.; Pazderka, V. (Charles Univ., Prague). Strahlentherapie; 144: No. 2, 227-33(Aug 1972). (In German).

The deviation of radiocalcium and strontium uptake in bones of white rats, damaged by irradiation, was evaluated together with morphological material. In irradiated bones, necrotic and reparative processes were found, depending on the irradiation dose. In the contralateral bones morphologically no deviation was found. (auth)

5526 EFFECT OF MECYTOSINE ON THE ANTIBLASTOMIC ACTION OF RADIATION. Vershinina, S. F.; Maksimova, O. V. (Central Roentgeno-Radiological Inst., Leningrad). Vop. Onkol.; 18: No. 8, 80-2(1972). (In Russian).

The effect of the radiosensitizer mecytosine (2-amino-4-methyl-6-oxypyrimidine) on the antineoplastic action of radiation and on radiosensitivity of animals has been studied. The experiments were carried out on 935 mice with transplantable tumors: lymphosarcoma, melanoma, squamous cell cancer of skin, hepatoma, sarcoma, and Ehrlich tumor. The criteria for estimation of the antitumor effect were as follows: tumor weight at the end of the experiment, hematological index, and animals' survival. A radiosensitizing effect of mecytosine was manifested mainly on epithelial tumors, and it was insignificant or totally absent in experimental leukoses, melanoma, and sarcoma. Moreover, mecytosine did not inhibit leukopoiesis and had no effect on the survival of mice subjected to x ray therapy. (auth)

5527 STUDY ON THE INFLUENCE OF COMBINED APPLICATION OF IONISING RAYS AND CYCLOPHOSPHAMIDE ON THE COLONY-FORMING HEMOPOIETIC STEM CELLS. Michailow, W.; Mitrov, G. G.; Zographov, D. G. Strahlentherapie; 144: No. 1, 87-95(Jul 1972). (In German).

In the course of experiments on mice, with the aid of the exogenous respectively endogenous colony-forming method by Till and McCulloch, it was demonstrated that cyclophosphamide, although not sensitising colony-forming cells against irradiation, inhibits the regeneration following irradiation, if applied ten minutes respectively ten hours after the irradiation; cyclophosphamide provokes a short-lasting decrease of the number of colony-forming cells in the bone marrow, which is followed by normalisation, with transitory hyperplasia in the spleen; the effect of ionizing rays and cyclophosphamide, used separately or in combination, on colony-forming cells is better in the phase of exponential growth. The significance of these results for the protection of the hemopoiesis, during combined application of ionising rays and cyclophosphamide, is discussed. (auth)

5528 EXCYSTATION AND DEVELOPMENT IN CELL CULTURE OF IRRADIATED OOCYSTS OF EIMERIA TENELLA. Klimes, B.; Tanielian, Z.; Ali, N. A. (Lebanon Animal Health Inst., Beirut). J. Protozool.; 19: No. 3, 500-4(1972).

Irradiation of sporulated oocysts of Eimeria tenella with 7,000; 13,000-14,000; or 20,000-21,000 rads of gamma rays does not kill the sporozoites or diminish their ability to penetrate cells in chicken kidney cell culture. Schizogony is the developmental stage most influenced by irradiation of oocysts. Effects on division and formation of merozoites correspond to irradiation levels. (auth)

5529 EFFECT OF ADENOSINETRIPHOSPHATE (ATP) ON THE DEVELOPMENT OF RADIATION INJURY TO LIVER PARENCHYMAL CELLS IN RAT. Zyss, R.; Gajkowska, B.; Michalska-Kaszynska, M. (Military Postgraduate Medical School, Warsaw). Pol. Med. J.; 11: No. 3, 610-25(1972).

Oxidative phosphorylation is known to be closely connected with mitochondria. X-irradiation quickly dissociates and inhibits

oxidative phosphorylation and damages the structure of mitochondria. The normal course of processes of oxidative phosphorylation depends on appropriate concentrations of adenosinetriphosphate (ATP). Changes in the content of this compound influence the structure of mitochondria (swelling, contraction). These facts suggest that radiation lesions in cells may be due to changes in ATP content. Experiments were therefore performed to ascertain whether administration of ATP exerts an appreciable effect on the radiation lesions in liver cells of rats irradiated with 1000 r. ATP was administered in doses of 100 mg/ml one hour before irradiation and in the course of 1 to 10 days after irradiation. Changes in cell structure (mainly mitochondria) and histo- and cytochemical reactions for nucleic acids, glycogen, lipids, SDH and ATP-ase activities were observed. Administration of ATP protected the liver cells from the effect of radiation. Changes in mitochondrial structure and in the contents of nucleic acids, glycogen and lipids appearing later (5 to 7 days after irradiation) were much less intensive, and involved a smaller number of cells in the liver lobules. The histo- and cytochemical reactions for SDH and ATP-ase showed virtually no difference from the controls throughout the period of observation. (auth)

5530 BRAIN TUMORS IN IRRADIATED MONKEYS. Haymaker, W. (Ames Research Center, Moffett Field, Calif.); Miquel, J.; Rubinstein, L. J. Acta Neuropathol.; 20: No. 4, 267-77(1972).

A study was made of 32 monkeys that survived one to seven years years after whole-body exposure to protons or to high-energy x rays. Among these 32 monkeys there were 21 that survived two years or longer after exposure to 200 to 800 rad. Glioblastoma multiforme developed in 3 of the 10 monkeys surviving three to five years after receiving 600 or 800 rad 55-MeV protons. Thus, the incidence of tumor development in the present series was far higher than the incidence of spontaneously developing brain tumors in monkeys cited in the literature. This suggests that the tumors in the present series may have been radiation-induced. (GF)

5531 CONTRIBUTION TO THE CHEMICAL RADIOPROTECTION IN RABBITS. Kuna, P. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). Stud. Biophys.; 30: No. 3, 211-16(1972).

The protective effects of cystamine, AET, and several mixtures were verified in lethally irradiated rabbits. Radioprotectors were given intravenously in a rapid injection (20 to 30 sec) or in 4 to 6 min infusion. The interval between the end of administration and the beginning of irradiation was termed 7 to 10 min. Infusions of cystamine (90 or 100 mg/kg) and a combination of cystamine (50 mg/kg), AET (60 mg/kg), and serotonin (40 mg/kg) afforded the significant radioprotection. Atropine (1 mg/kg) did not influence the protective effect of cystamine infusion. Mixtures of cystamine and AET have shown a marked but insignificant radioprotective effect. (auth)

5532 RELATIONSHIP BETWEEN A DURATION OF LATENT TIME AND EXPOSED DOSE IN RADIATION INDUCED UNNEOPLASMIC LATE EFFECTS IN MAMMALS. Ueno, Y. (Kyoto Univ.). Stud. Biophys.; 30: No. 3, 231-5(1972).

An attempt was made to establish a relation between the duration of the latent period and radiation dose for radioinduced nonneoplastic late effects in mammals. An assumption was made, on the basis of the literature studied, that a long life span of the cells closely related to the late effect is one of the important factors limiting the duration of the latent period. On the basis of this assumption, the similarity of curves relating radiation dose to duration of latent period independent of the kind of effect is understandable. (E.R.B.)

5533 EFFECTS OF X-IRRADIATION ON THE CONTENT OF AMINO ACIDS IN THE DEVELOPING RAT CEREBELLUM. Valcana, T.; Hudson, D.; Timiras, P. S. (Univ. of California, Berkeley). J. Neurochem.; 19: No. 9, 2229-32(Sep 1972).

A comparison is made of the developmental patterns of free amino acids in the cerebellum of control and x-irradiated rats. To determine whether any differences observed could be accepted as general to all brain areas or specific to the cerebellum, the cerebral cortex and brain stem were also studied at the earliest post-radiation interval. (auth)

5534 AGING OF CONNECTIVE TISSUE. THE EFFECT OF DIET AND X-IRRADIATION. Svojtkova, E.; Deyl, Z.; Rosmus, J.; Adam, M. (Health Inst. of Uranium Industry, Prague). Exp. Gerontol.; 7: No. 3, 157-67(1972).

The effects of decreased food intake, of fat rich diet, and of x radiation on rats were studied. Each of these treatments is known to influence collagen maturation in vivo. It was established that undernutrition retards aging of collagen preferentially when applied to young animals. High fat diet was proved to increase collagen stability, presumably by inducing new hydrophobic contacts. The effect of irradiation is strongly dose-dependent and reflects simultaneously occurring polymerization and depolymerization of the structure. In atherogenic diet-fed animals, ionizing radiation has a predominantly polymerizing effect, which appears to be the result of the conversion of hydrophobic contacts in two other types of bonds. On the tissue level it was observed that high fat diet causes a pronounced accumulation of collagenous stroma in organs that otherwise exhibit low rate of collagen turnover. (auth)

5535 RADIOPROTECTIVE EFFECT OF GROUNDNUT OIL. Korgaonkar, K. S.; Ghanekar, Sunanda P. (Cancer Research Inst., Bombay). Indian J. Biochem. Biophys.; 9: No. 1, 116-18(Mar 1972).

Subcutaneous injections of groundnut (peanut) oil showed 10 to 20% reduction in the lethality of rats exposed to whole-body single dose (900 to 1100 rad) of γ irradiation. Treatment with this oil also gave marked protection to skin in local irradiation experiments with 220 and 70 kV x rays in rabbits as well as cancer patients. (auth)

5536 ARREST OF CELL DIVISION AND HEMOGLOBIN SYNTHESIS IN DIFFERENTIATING YOLK SAC ERYTHROID CELLS. Fantoni, A.; Ghiara, L.; Pozzi, L. V. (CNEN, Rome). Biochim. Biophys. Acta; 269: 141-52(26 Apr 1972).

Yolk sac derived erythroid cells of C57B1/Cas fetal mice that are x-irradiated with 120 rads at the 10th day of fetal development perform three normal cell cycles and synthesize hemoglobin in a normal fashion until day 12. Between day 12 and 13 normal cells perform one final cell cycle and reduce to half the rate of hemoglobin synthesis per cell; conversely, irradiated erythroid cells do not divide and maintain the full rate of hemoglobin formation. At day 13, irradiated non-divided erythroid cells contain polyribosomes in the same amount and with the same size distribution as normally divided cells and yet synthesize hemoglobin at a two-fold faster rate. This difference of hemoglobin synthesizing capacity is not due to new formation of messenger RNA for hemoglobin, neither is it due to a faster rate of translation, but rather because at day 13 non-divided erythroid cells have maintained the full complement of messenger RNA-ribosomal complexes active for hemoglobin synthesis, while in normally divided erythroid cells the number of messenger RNA-ribosomal complexes active for hemoglobin synthesis is cleaved in the course of cell division. In the irradiated erythroid population, the total amount of each globin chain produced in the course of differentiation is not decreased in spite of the arrest of cell division. These data suggest that the total amount of hemoglobin produced during the development of the progeny of a single erythroid cell is programmed in early stages of erythroid differentiation. (auth)

5537 RADIOPROTECTIVE EFFECT OF SCHIZANDRA-CHINENSIS-OIL IN MICE. Brueckner, V.; Rehmann, A. (Univ., Hamburg). Stud. Biophys.; 30: No. 1, 27-8(1972). (In German).

The fatty oil of Schizandra-chinensis turned out to be a prominent radioprotector. When this substance was injected 24 hrs before whole-body x irradiation of mice, we could significantly increase their survival rate from 8% to 58%. (auth)

5538 EFFECT OF TETRAHYDROFOLIC ACID (FAH_4) ON SURVIVAL RATE OF ENDOGENOUS SPLEEN COLONY FORMING CELLS OF MICE FOLLOWING X-IRRADIATION. Ueno, Y. (Kyoto Univ.). Stud. Biophys.; 33: No. 2, 131-6(1972).

The effect of tetrahydrofolic acid (FAH_4), N-{p{[(2-amino-4 hydroxy-5, 6, 7, 8 tetrahydro-6 pteridinyl)-methyl] amino}benzoyl} glutamic acid, on the survival rate of endogeneous spleen colony forming cells following single and repeated x irradiation was studied. FAH_4 administered intraperitoneally within 1 hr following each irradiation to 70 R (repeated) did not inhibit reduction in the survival rates of the cell. (auth)

5539 RADIATION LEUKEMIA PROTECTION (RLP) ACTIVITY OF SOME COHN FRACTIONS OF SERUM. Hodes, M. E.; Yip, L. C.; Lewis, W. M.; (and others) (Indiana Univ., Indianapolis). Contract AT(11-1)-1391. Oncology; 26: No. 5, 409-21(1972).

Several of the Cohn fractions obtained from sheep serum were partially resolved on DEAE-cellulose columns. The fractions obtained from the columns were tested for their ability to prevent leukemia in x-irradiated C57BL/6 mice. No consistent pattern of fractionation of the radiation-leukemia prevention (RLP) factor was found, and no correlation between fractions exhibiting RLP and trypsin-esterase binding ($\alpha_2$macroglobulin) activity was possible. (auth)

5540 BIOLOGICAL RADIATION EFFECTS. Akita, K. (Tokyo Univ.). pp 225-89 of Studies on Radiation Effects. /Hiyama, Yoshio (ed.). Tokyo; Tokyo Daigaku Shuppankai (1971). (In Japanese).

Radiation injuries are damages of the function of cell proliferation as predicted by the classic target theory. The paper presents reviews on molecular structure of radionuclides affecting animals, radiation effects on animal cells, and radiation effects on specific organism. Physical and chemical analysis of irradiation function, RBE and direct and indirect effects, target theory, biological repair process, DNA repair function and its effects on organic evolution are subsequently discussed regarding molecular structure of radionuclides. Reviewing results of neoplasm experiments, mechanism of mitotic death, reproductive death and interphase death, and genetic radiation effects were specifically discussed in terms of ultrastructural cell level such as mitochondria and cell nuclei. Comparative analysis of radiosensitivity and specific genes recently developed as the result of animal experiments was briefly described. It is well known that proliferation of malignant tumor cells frequently occurred as an acute radiation injury when mammals are irradiated with an overdose. After having recovered from this injury, there still exists the unknown factor called nonspecific shortening of life-span as very delayed radiation effects, which mechanism has not been clarified yet theoretically as well as clinically. Further studies on RBE and shortening of life span should be carried out systematically for the development of radiology. (Japan)

5541 IN VIVO SEEDING OF HEMOPOIETIC COLONY-FORMING CELLS IN IRRADIATED MICE. Testa, N. G.; Lord, B. I.; Shore, N. A. (Paterson Labs., Manchester, Eng.). Blood; 40: No. 5, 654-61(Nov 1972).

The seeding of transplanted CFU_C and CFU_S in the spleen and femur of irradiated mice has been investigated in order to compare their kinetic behavior following transplantation. The conditions in which the seeding of transplanted CFU_C into lethally irradiated recipient mice can be studied were determined. Irradiated femoral or splenic cells produce potentiation of colony growth when added in relatively low numbers and result in serious inhibition at higher concentrations. By using a preirradiated recipient in which the postirradiation cell loss has been completed, rather than one that has only just been irradiated, changes in plating efficiency during the course of the experiment are prevented in the spleen and are maintained constant in the femur. It is shown that significant numbers of CFU_C and CFU_S quickly appear in both the spleen and bone marrow after transplantation. A fall in CFU_C numbers occurs after 2 to 3 hr both in femur and spleen, while CFU_S numbers remain stable. The possible mechanisms involved are considered, and differentiation is suggested as the cause of the fall. (auth)

5542 RADIORESISTANCE OF CARRIER-SPECIFIC HELPER THYMUS-DERIVED LYMPHOCYTES IN MICE. Hamaoka, Toshiyuki; Katz, D. H.; Benacerraf, Baruj (Harvard Medical School, Boston). Proc. Nat. Acad. Sci. U. S. A.; 69: No. 11, 3453-8(Nov 1972).

The effect of x-irradiation on the capacity of carrier-specific mouse T (thymus-derived) lymphocytes to exert a helper function for hapten-specific B (bone marrow-derived) lymphocytes in vivo has been investigated again. Helper function is abolished by exposure of such cells to x-irradiation before, or immediately after, transfer to adoptive hosts. On the other hand, when exposure to x-irradiation occurs under circumstances in which the carrier-primed cells are well-localized in the appropriate lymphoid organs, i.e., either in the carrier-primed animal or 24 hr after adoptive transfer to syngeneic recipients, the capacity of T lymphocytes to serve as specific helper cells is clearly radioresistant. Evidence indicates that x-irradiation results in undefined, and subtle, changes in the migratory capacity of mouse T lymphocytes, but not in abrogation of T-cell helper functions. (auth)

5543 STUDIES ON THE EFFECT OF 1-(2-DIMETHYLAMINOETHYL) CYCLOHEPTIMIDAZOL-2(IH)-ONE IN THE TREATMENT OF CANCER. 6. STUDY ON RADIOSENSITIZING EFFECT OF AMETOHEPAZON AND COMBINED USE OF AMETOHEPAZON AND 5-FLUOROURACIL ON AH 109 A SOLID TUMOR. Hayashi, H.; Imai, T.; Inoue, N.; Tabeta, Y.; Ohazama, H. (Tokyo Univ.). Nippon Kokoka Gakkai Zasshi; 19: No. 1, 196-205(Jan 1970). (In Japanese).

The present experiments were made in order to see the radiation sensitizing effect of Ametohepazon [1-(2-dimethylaminoethyl) cycloheptimidazol-2(IH)-one] and combination of Amertohepazon and 5-fluorouracil on ascites hepatoma AH-109A. Ascites form tumor cells of AH-109A were transplanted subcutaneously in the tail of Donryu rats to produce a solid tumor. The tumor was irradiated with 250 R of x rays, once a day for 4 days to a total dose of 1,000 R. The rats were divided into seven groups: group I of control without irradiation or medication, and transplantation alone; group II given x irradiation; group III given 100 mg/kg of Ametohepazon before x irradiation; group IV given 5 mg/kg of 5-fluorouracil without irradiation; group V given 50 mg/kg of Ametohepazon and 2.5 mg of 5-fluorouracil without irradiation; group VI given 5 mg/kg of 5-fluorouracil followed by irradiation; and group VII, combination of 50 mg/kg of Ametohepazon and 0.25 mg/kg of 5-fluorouracil followed by irradiation. Final judgement was made on the enlargement or diminution of the tumor. Rats that died during the experiment, found comparatively early after death, were autopsied to make histological examination of the tumor tissue. Significant diminution of the tumor occurred in group III animals compared to group II. In group VII, a significant diminution of the tumor over that of group III was observed by extension of the observation period to 170 days. From these results, Ametohepazon seems to be effective in increasing radiation sensitivity and its combination with 5-fluorouracil seemed more effective. (Japan)

5544 EFFECTS OF DIET SUPPLEMENTS AND GAMMA IRRADIATION ON DISSIMILATION OF LOW-QUALITY ROUGHAGES BY RUMINANTS. 2. EFFECTS OF GAMMA IRRADIATION AND UREA SUPPLEMENTATION ON DISSIMILATION IN THE RUMEN. McManus, W. R. (New South Wales Univ., Kensington, Australia); Manta, L.; McFarlane, J. D.; Gray, A. C. J. Agr. Sci.; 79: No. 1, 41-53(Aug 1972).

Results of two in vivo sheep experiments in which gamma-irradiated material in terylene bags was fermented in the rumen are reported. The first experiment concerning the testing of rice straw, nassella (Nassella trichotoma) and cotton lint, each subjected to six dose levels of gamma irradiation (0, 5, 10, 25, 100, and 200 Mrad) when wet and when in the dry state. The tests were made in sheep fed either a lucerne hay or a rice-straw base diet. Dry-matter disappearance of all test materials was influenced by irradiation treatment: levels of 10 and in some instances 25 Mrad depressed, and other levels substantially enhanced, intraruminal degradation rate tested over 72 hr. Materials irradiated in the dry state were better dissimilated than those irradiated in the wet state. Intraruminal dissimilation of irradiated test material from terylene bags was always greater on lucerne hay base diets than on rice straw base diets. In the second experiment the influence of urea supplementation was investigated, at levels of 1% and 2% of diet, on the dissimilation of irradiated test samples of cotton lint and rice straw for sheep fed a rice-straw base diet. Similar effects of irradiation on cotton lint and rice straw to those found in the first experiment were observed. It is considered that feeding trials with low-quality roughages irradiated at levels at or greater than 25 Mrad are warranted. (auth)

Invertebrates

Refer also to abstract 5466.

5545 STUDY ON THE MATING ABILITY AND COMPETITIVENESS OF THE RADIATION IRRADIATED MALES OF RICE STEM BORER. Hyun, J. S.; Ryu, J.; Chung, K. H.; Kwon, S. H. Han'guk Sikmul Poho Hakhoe Chi; 11: No. 1, 25-30(1972).

Five to seven day old pupae were irradiated with gamma rays, the mating ability, and competibility of the irradiated males were examined. The results obtained are summarized as follows: There is no difference in percentage of males that mated, nor in the maximum number of matings of the males, when individual matings were made, and fresh females were provided every day for his life time. The average days for the first mating of the emerged were 1.5 days for the control, and 2.4 days for the males irradiated with 25 and 30 Krad. The average days between first and second mating were 3.0 days for the irradiated males, and 1.3 days for the control. The average matings of a male were 1.2 and 2.5 times when 5 and 10 females were provided to a normal male respectively. No significant difference in average numbers of mated female per male were observed between the normal and irradiated males. To test the mating competitiveness, the irradiated and normal males (1:0, 1:1, 2:1, 1:2, 5:1, 1:5, and 0:1) were confined together with five virgin females. The greatest reduction in hatching percentage was found with 5:1:1 (30 Krad) where 26.6% was hatched. The results showed that the irradiated males were not fully competitive with normal males, but if the reduced number of eggs produced by the female mated with irradiated male is considered, sterile male techniques in rice stem borer control might be useful. (Korean Sci. Abstr.)

5546 PERMEABILITY OF THE PROTOZOAN CELL MEMBRANE TO WATER AND IONS UNDER THE ACTION OF ULTRA-

VIOLET LIGHT. Hildebrand, E.; Stieve, H. (Technische Hochschule, Aachen). Z. Naturforsch.; 27b: No. 10, 1243-57(Oct 1972). (In German).

The action of ultraviolet light on certain membrane properties of protozoa was investigated in Paramecium, Euplotes, and Opalina using the following methods: observation of morphological changes of the animals, recording of the osmoregulatory organelle (Paramecium), and measurement of membrane potential and resistance by means of intracellularly inserted microelectrodes. This paper presents only slow effects that occur within some minutes after uv irradiation and does not directly concern excitability of protozoa. Due to large uv doses, swelling was observed both in Paramecium and Opalina; in Euplotes a liquid-filled vacuole was formed. Small uv doses cause an increase in the frequency of the contractile vacuole of Paramecium; larger doses diminish the frequency reversibly, and even larger doses lead to an irreversible inactivation of this organelle. Membrane potential and membrane resistance in Opalina are shown to change in different ways under continuous irradiation: After a transient decrease, the membrane potential increases to about the initial value and after this it decreases to zero, whereas the membrane resistance decreases from the beginning of irradiation. The spectral sensitivity curve obtained from a standard decrease of the membrane potential shows a maximum at about 280 nm and a rise from 250 nm towards shorter wavelengths. The results indicate an influx of water following the osmotic gradient and an increase of the membrane permeability to cations. With respect to the different behavior of membrane potential and conductivity, the mechanism of uv action is discussed. The most probable assumption is that the permeability increases unspecifically but gradually in succession for water, chloride, potassium, and sodium. The possibility of disruption of disulfide links is discussed with respect to the spectral sensitivity curve. It is suggested that the altered permeability is based on photochemically induced changes of the structure of proteins that are either part of the membrane or have an important function in the regulation of the membrane permeability. (auth)

5547 MODIFICATIONS OF THE HAEMOGRAMME OF LARVAL AND ADULT LOCUSTA MIGRATORIA AFTER SELECTIVE X-IRRADIATIONS OF THE HAEMOCYTOPOIETIC TISSUE. Hoffmann, Jules A. (Univ. Louis Pasteur, Strasbourg). J. Insect Physiol.; 18: No. 9, 1639-52(Sep 1972).

Twenty-four hours after a selective irradiation of the hemocytopoietic tissue (phagocytic tissue) of larval and adult locusts, the total hemocyte number falls by approximately 50% of its initial figure. The decrease is not equivalent for the three main hemocyte types: it is strongest for the coagulocytes and weakest for the the granular hemocytes. The recovery period of the hemogramme lasts 5 to 6 days and is characterized by a strong temporary increase in the figure of poorly differentiated hemocytes (plasmatocyte-like cells). Sham irradiations in a ventral abdominal region (same dose, equivalent surface area) do not affect the hemogramme. The dramatic decrease in the number of circulating hemocytes after irradiation of the highly radiosensitive hemocytopoietic tissue brings the ultimate proof of its important role in the production of hemocytes at different developmental stages, and is in complete agreement with our former morphological and physiological studies. (auth)

5548 STUDIES ON THE MATING COMPETITIVENESS AND RESTORATION OF SPERM VIABILITY IN THE GAMMA-IRRADIATED POPULATION OF TETRANYCHUS ARABICUS ATTIAH (ACRINA: TETRANYCHIDAE). Elbadry, E. A.; Wakid, A. M.; Abd Ellall, M. A. (Ain Shams Univ., Cairo). Z. Angew. Entomol.; 71: No. 2, 178-81(Jul 1972).

Tetranychus arabicus Attiah males that were treated as adults with 30 krad were found to be fully competitive with untreated males in fertilizing females in laboratory tests. Replacement of normal males with irradiated males in the natural mite population had no effect on egg hatchability. Insemination by normal males could not nullify insemination by irradiated males. Storage of sperms in the males after irradiation did not result in the restoration or recovery of sperm viability. (auth)

5549 MORTALITY AND ABNORMALITIES CAUSED BY GAMMA IRRADIATION OF ALFALFA WEEVIL PUPAE. Burgess, E. E.; Bennett, S. E. (Univ. of Tennessee, Knoxville). Ann. Entomol. Soc. Amer.; 65: No. 6, 1331-3(Nov 1972).

The effects of gamma radiation on Hypera postica (Gyllenhal) pupae of various ages were studied. Pupae (ages 3 to 6 hrs, 1, 2, 3, and 4 days) were irradiated at 1.7 to 10.0 kR. Pupae irradiated with 1.7 kR to 10.0 kR demonstrated significant differences from the control. A decline in mortality and abnormalities was noted with an increase in age of the pupal stage at irradiation. Some specimens that emerged after radiation had abnormal antennae, legs, and elytra. (auth)

5550 AUTONOMY OR NONAUTONOMY OF GENE EFFECTS IN MOSAICS (DROSOPHILA/SEX COMBS/X-RAYS/SOMATIC CROSSING OVER). Tokunaga, Chiyoko (Univ. of California, Berkeley). Proc. Nat. Acad. Sci. U. S. A.; 69: No. 11, 3283-6(Nov 1972).

The dominant autosomal gene Msc (Multiple sex combs) of Drosophila causes the appearance of sex combs on the second and third legs and a reduction of size of sex combs on first legs. The effect of Msc was studied in mosaic flies in which non-Msc spots were present on a Msc background. Mosaics were due to somatic crossing-over induced by x-rays. Analysis of mosaics suggested autonomy of the action of Msc, provided that the somatic crossing-over occurs less frequently proximally to the Msc locus than distally. This unusual ratio of somatic crossing-over was confirmed by a separate experiment with the gene Kinked, whose locus is very close to Msc. (auth)

5551 EFFECT OF OXYGEN ON THE FREQUENCY OF SOMATIC RECOMBINATION IN DROSOPHILA MELANOGASTER. Stauffer, H. H. (Univ. of California, Berkeley). Genetics; 72: No. 2, 277-91(Oct 1972).

The influence of oxygen on the frequency of somatic recombination in the yellow singed system on the X chromosome of Drosophila melanogaster was studied under a variety of experimental conditions. Flies raised from egg to adult in atmospheres containing 70 to 90% oxygen were found to have significantly more mosaic spots on their abdominal tergites than were observed in flies which developed in air. First instar larvae x-rayed in from 0 to 100% oxygen demonstrated the existence of an oxygen effect for somatic recombination in the cells which form the abdominal hypoderm. The mosaic spot counts, beginning with the lowest numbers which were found in flies x-rayed in nitrogen, increased rapidly with rising oxygen tensions until the percentage in air was reached, then leveled off at the higher concentrations. Post-treatment with nitrogen of larvae x-rayed in air or oxygen created a substantially higher number of mosaic spots than were found when larvae, after being similarly irradiated, were instead placed into air or oxygen. (auth)

5552 STABILITY OF RADIATION INJURY IN CELL POPULATION OF PARAMECIUM CAUDATUM. Bychkovskaya, I. B.; Malinovskii, O. V.; Ochinskaya, G. K.; Filippov, A. I. (Central Research Inst. of Roentgeno-Radiology, Leningrad). Dokl. Akad. Nauk SSSR; 205: No. 1, 213-15(1 Jul 1972). (In Russian).

Post-radiation destruction of protozoa was studied following x irradiation of Paramecium caudatum and amoebae with doses of 0.5 and 40 kR, and then observing the survival of descendants of the irradiated colony for periods up to 104 days. Survival rates were compared with controls. (K.S.W.)

5553 STUDIES ON RADIATION-ATTENUATED HELMINTH VACCINES: LABORATORY STUDIES ON THE PRODUCTION AND EVALUATION OF GAMMA-IRRADIATED VACCINE AGAINST THE SHEEP LUNGWORM, DICTYOCAULUS FILARIA. Tewari, H. C.; Gangadhara Rao, Y. V. B.; Dhar, D. N. (Indian Veterinary Research Inst., Izatnagar). Indian J. Anim. Sci.; 42: No. 1, 32-7(Jan 1972).

Laboratory experiments were conducted in lambs, 4 to 6 months of age, to determine the resistance produced as a result of double vaccination with the irradiated Dictyocaulus filaria larvae. Three groups of lambs were used. Group I was given the first vaccine dose of 1,000 larvae irradiated at 45 kR, followed by a second vaccine dose of 2,000 larvae irradiated at 45 kR after 28 days. Animals in group 2 were similarly vaccinated with larvae irradiated at 50 kR. The animals in the vaccinated and the unvaccinated control groups were challenged on 42nd day with 5,000 normal unirradiated larvae. All the surviving animals were killed on 84th day for detailed parasitological and pathological examinations. It was concluded that a significant protection was conferred on lambs following vaccination with a double dose of irradiated larvae. (auth)

5554 FOOD HYGIENIC STUDIES ON ANISAKIS LARVA. 3. EFFECT OF GAMMA IRRADIATION ON ANISAKIS LARVAE IN SALINE SOLUTION. Oishi, K.; Oka, S.; Hiraoki, M. (Hokkaido Univ., Japan). Nippon Suisan Gakkaishi; 38: No. 2, 133-6(Feb 1972). (In Japanese).

In a previously published paper, it was observed that killing of Anisakis worms is effective for the prevention of Anisakiasis. The illness is believed to be caused by the penetration of Anisakis worms into the human alimentary canal. This work aims to study the effectiveness of gamma irradiation from ^{60}Co in the killing of worms and its applicability to fish processing. The larvae were irradiated with doses of 0.0, 1.7 and 8.4 Krad; 0.0, 0.3, 0.6, and 1.0 Mrad in 0, 1, 3 and 6% saline solution. Moreover, the pro-

tective action of protein on Anisakis worms was estimated using a 17% egg white saline solution. The higher the doses applied, the higher the mortality observed over 10 days, though less than 60% mortality was observed on the first day of irradiation, even with a dose of 1.0 Mrad in 6% NaCl. Therefore irradiation is not applicable to food processing, because unfavorable decomposition of food constituents may occur with doses higher than 0.6 Mrad. As for the effect of saline concentration, the worms in 1% saline solution showed greater resistance than those in 0 or 3% solutions. On addition of egg white, a protective effect was observed for 4 or 5 days. In conclusion, irradiation is not applicable for killing Anisakis worms under conditions of fish processing. (auth)

Radionuclide Effects (Internal Source)

Man

5555 (KFK-EXT-23/72-1) ESTIMATE OF THE ^{241}Am BODY BURDEN DUE TO INCORPORATION THROUGH A CONTAMINATED WOUND. Schieferdecker, H. (Kernforschungszentrum (West Germany)). Mar 1972. 11p. (In German). Dep. NTIS (U. S. Sales Only).

In the case of a human wound contamination with ^{241}Am the resultant body burden was estimated by urinalyses to be less than 1 nCi of ^{241}Am. The basis of calculation and the effectiveness of DTPA treatment for increasing the excretion of ^{241}Am are discussed. (auth)

5556 MEASUREMENT OF RETENTION AFTER INHALATION OF ^{60}Co AND ^{54}Mn ON PERSONS, RADIATION-EXPOSED BY PROFESSION. Poulheim, K.-F.; Klucke, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Strahlentherapie; 144: No. 2, 201-7(Aug 1972). (In German).

On occasion of a routine-supervision of radiation exposure, in the counter for whole-body gamma activity, incorporations of ^{60}Co and ^{54}Mn were found in the lungs of three persons, just repairing a reactor under equal working conditions. Measurements of retention showed effective half-life periods of 167, 257 and 267 days for the slow component of ^{60}Co, and effective half-life periods of 95, 93 and 95 days for the slow component of ^{54}Mn. The doses were valued. (auth)

Animals

5557 PROMPT EFFECTS OF RADIATION ON THE HEART RATE OF A MAMMALIAN EMBRYO. Norris, J. A. (Atomic Energy Commission, Washington, D. C.); Robkin, M. A.; Shepard, T. H. Trans. Amer. Nucl. Soc.; 15: No. 2, 714(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Plants

Refer also to abstract 5469.

5558 AIR POLLUTION EFFECTS ON VEGETATION. Keller, T. (Eidg. Anstalt Forstl. Versuchswes., Birmensdorf, Switzerland). Staedtehygiene; 22: No. 6, 130-6(1971). (In German).

A review with 16 references is given describing the phytotoxic effects of dusts (including radioactive substances) and gases (SO_2, and F) on plants. Selection of specific plants for cultivation, plant breeding, and fertilization are given as possible measurements against air pollution injuries. (EURATOM)

Nuclide Kinetics and Toxicology

Man

5559 (EUR-4800(Vols.1 and 2), pp 1017-22) TRANSFER PARAMETERS FOR RADIOACTIVE CONTAMINATION IN THE ENVIRONMENT. Bourdeau, Ph. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Estimation of the risks of radioactive contamination demands as precise a knowledge as possible of the transfer of radionuclides from the physical environment to living organisms and between the living organisms constituting the food chains. Different ways of expressing and calculating these transfers are reviewed. The paper deals with the concepts of the concentration factor and specific activity, the influence of the physico-chemical state of the radionuclide and physiological factors, and the special case of non-equilibrium conditions. Suggestions are made as to the most useful form of expressing the transfer function for radioprotection purposes. (auth)

5560 FURTHER STUDIES ON THE LONG-TERM EVALUATION OF THE BIOLOGICAL HALF-LIFE OF TRITIUM. Moghissi, A. A.; Carter, M. W.; Bretthauer, E. W. (Environmental Protection Agency, Las Vegas, Nev.). Health Phys.; 23: No. 6, 805-6(Dec 1972).

In a previously published study (Moghissi, Carter, Lieberman. Health Phys.; 21: 57(1971)) it was reported that the eliminations of tritium from two human subjects followed a multi-component curve. Additional data have been collected on one of the subjects who exhibited a long half-life component of 2020 days which revise that estimate to 550 days. Another subject who received an industrial exposure was studied, and the results indicate a long half-life of 350 days for this subject. A possible seasonal variation in tritium excretion noted in the previous report was confirmed by the additional data now reported. (auth)

5561 TKANE-DOZIMETRICHESKIE KHARAKTERISTIKI RADIOAKTIVNOGO IODA-131. (Tissue-Dosimetric Characteristics of Radioactive ^{131}I). Moiseev, A. A. Moscow; Ministerstvo Zdravookhraneniya SSSR, Tsentral'nyi Ordena Lenina Institut Usovershenstvovaniya Vrachei (1972). 15p.

Mathematical treatments are presented for computing the thyroid uptake of ^{131}I by man following inhalation or ingestion. Special factors such as the diameter of the particle, and constants representing biological half-lives in various organs, are taken into account. (K.S.W.)

5562 CHEST CLEARANCE OF INHALED ^{60}Co OXIDE. Gupton, E. D.; Brown, P. E. (Oak Ridge National Lab., Tenn.). Health Phys.; 23: No. 6, 767-9(Dec 1972).

Chest counting data were collected for about 4 yr for a case that involved inhalation of ^{60}Co-oxide. The measured chest burden, that decreases with successively increasing half-times (about 10 months at early times to about 30 months after 3 yr), may be calculated almost precisely with an expression related directly to the model of the Task Group on Lung Dynamics. Only the delayed transfer half-time and the long-term fraction retained in pulmonary lymph nodes of the Class Y model need be adjusted to fit this case. With the exception of the long-term fraction in the lymph nodes, only one rate of elimination seems to be present, 225 days, throughout the period of observation. (auth)

5563 MEASUREMENT OF ^{252}Cf IN VIVO. Newton, D.; Eagle, M. C. (Atomic Energy Research Establishment, Harwell, Eng.). Health Phys.; 23: No. 6, 817-25(Dec 1972).

If standard whole-body counting techniques are used to assess skeletal burdens of ^{252}Cf, difficulties may arise in the interpretation of spectra in the energy region below 0.4 MeV, where the principal gamma-ray flux from the contaminant appears. There will often be advantages in studying the much weaker contributions above 1.7 MeV, eliminating interference from ^{40}K and ^{137}Cs. A major component of these contributions arises from radiative capture of the fission neutrons in hydrogen, and a technique was devised to overcome certain calibration problems and other difficulties that occur when gamma-rays produced by this mechanism are measured. (auth)

Animals

5564 (CEA-CONF-1994) INFLUENCING OF THE CLEARANCE RATE OF INHALED $^{59}Fe_2O_3$ PARTICLES THROUGH METOPIRONE. Schorn, H.; Walter, C.; Lafuma, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1971. 10p. (In German). (CONF-720126-1). Dep. NTIS (U. S. Sales Only).

From 10th international symposium on radioactive isotopes in clinic and research; Bad Gastein, Austria (10 Jan 1972).

The effectiveness of metopirone (2-methyl-1, 2-di-3-pridyl-1-propanone) for the removal of inhaled $^{59}Fe_2O_3$ from the lungs of rats was demonstrated. The clearance rate depended on the dose and time of administration. The administration of metopirone inhibited the mobility of lung marophages and decreased their uptake of the iron oxide aerosol particles. (C.H.)

5565 (EUR-4800(Vols.1 and 2), pp 1121-33) TRITIUM SECRETION INTO COW'S MILK AFTER ADMINISTRATION OF ORGANICALLY BOUND TRITIUM AND OF TRITIATED WATER. Van Den Hoek, J. (Agricultural Univ., Wageningen, The Netherlands); Kirchmann, R. May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Tritium secretion in milk was studied in lactating cows after administration of tritiated water and of organically bound tritium. Tritium activity was determined in milk-water, milk-fat, casein, and total dry matter. After administration of a single oral dose of tritiated water, maximum activities amounted to about 0.2% of the dose per liter of milk for milk-water and to 0.002% or less for milk constituents. These activities were reached one and three days after dosing in milk water and in milk constituents respectively. Tritium activity decreased with half-lives of about 4 days for all components studied. Organically bound tritium was obtained by spraying a normal pasture several times with tritiated water. The grass was cut and transformed to hay that was fed to lactating cows. Milk-fat, casein, and total dry matter contained about 10 to 20 times more tritium per gram than did milk-water. Over 1% of the daily ingested tritium was secreted per liter of milk after one week of hayfeeding and more than half this amount was found in milk constituents. Specific activity values (pCi $^{3}H/g$ H) in the various milk components after different ways of tritium administration are compared, and the physiological and health-physics implications of these findings are discussed. (auth)

5566 (EUR-4800(Vols.1 and 2), pp 1177-1211) STUDY OF THE FIXATION AND DESORPTION OF RADIOSTRONTIUM BY ANGUILLA ANGUILLA (L) IN FRESH WATER AND SALT WATER AND ITS TRANSFER TO MAN THROUGH FOOD. Foulquier, L.; Marcoux, G.; Grauby, A. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

In the Rhone delta, a natural outlet for all forms of pollution, there is intensive eel fishing and extensive exports of eels. The wide geographical distribution of this fish, its biomass, the ease with which it is harvested, its euryhalinity, and its consumption make it a prime subject for radioecological studies and health protection. These reasons have led the authors to undertake such a study with radiostrontium, in view of its physiological importance and its importance to health. In freshwater, the dynamics of the contamination measured on living creatures shows that strontium is fixed rapidly during the first fifteen days and that a state of equilibrium is reached at the end of about 70 days. At this stage the concentration factor is of the order of 1.3. Measurements of the variation in specific activity of the organs as a function of time seem to indicate that they divide into three main groups according to the rate of exchange. Although the skeleton has the highest concentration factor, the muscles represent about 20% of the quantity of strontium retained. When placed in a circuit of inactive water, the eels lose 30 to 50% of their activity at the end of 45 days. In saltwater, the same experiments show that the distribution of the element and its rate of fixation are very close to that observed in freshwater. From these results, the authors try to determine, by using different culinary preparations, the proportion of strontium that can pass directly into man's food intake. (auth)

5567 (EUR-4800(Vols.1 and 2), pp 1277-1304) OBSERVATIONS ON THE EXPERIMENTAL CONTAMINATION OF THREE SPECIES OF SEA FISH: PLEURONECTES PLATESSA L., CALLIONYMUS LYRA L. AND TRACHINUS VIPERA CUV., BY ^{137}Cs AND ^{60}Co. Fraizier, A.; Ancellin, J. (CEA, Cherbourg, France). May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The study relates to three species of sea fish living on sandy bottoms: Pleuronectes platessa L., Callionymus Lyra L., and Trachinus vipera Cuv.; the experimental contamination was produced with cesium-137 and cobalt-60 in aquaria with and without sediment. Data are provided on the variation of the physicochemical forms and the distribution of the radionuclides in the aquaria. At the end of the experiment, which was continued for two months, the contamination of the fish had not reached the equilibrium state; the concentration factor for the whole creature were of the order of 4 to 5 for cesium and 2 to 3 for cobalt. A study of the distribution of each radionuclide in the organs and as a function of time, carried out for Pleuronectes platessa L., made it possible to distinguish several phases in the development of the contamination. At the end of the experiments the most contaminated organs were: for cesium: the heart, the gastrointestinal tract, and the liver (concentration factor: 10); and for cobalt: the kidney and the liver (concentration factor: 5 to 6). The concentration factor of the skin was moreover ten times higher for cesium than for cobalt. It is noted that compared with that of water, the contribution of the sediment in the contamination of the fish remained very low and difficult to calculate. (auth)

5568 (EUR-4800(Vols.1 and 2), pp 1327-44) EFFECTS OF SUBLETHAL AMOUNTS OF CADMIUM AND MERCURY ON THE METABOLISM OF ^{65}Zn BY FRESHWATER FISH. Merlini, Margaret; Argentesi, F.; Brazzelli, A.; Oregioni, B.; Pozzi, G. (C.C.R., Ispra, Italy). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

It is known that aquatic environments that receive nuclear reactor effluents contain the neutron-induced radionuclide zinc-65. As a result, aquatic organisms are exposed to a radioactive essential micronutrient known to be physiologically important. Thus, radiozinc enters into the metabolic pools of these organisms just as its stable counterpart. Recent studies utilizing ^{65}Zn have helped delineate the biological pathway of this essential element for a better understanding of mineral metabolism and the fate of this important nuclide in an edible freshwater fish, Lepomis gibbosus, L. from Lake Maggiore (northern Italy). In addition, increased industrial and agricultural pollution makes urgent studies of the effects of heavy metals on vital physiological processes. Cadmium and mercury are two of the heavy metals frequently encountered as pollutants of inland waters and they affect the normal behavior of zinc in freshwater fish. The results of studies conducted on the effects of sublethal quantities of Cd and Hg on the metabolism of ^{65}Zn in Lepomis gibbosus are presented and discussed. (auth)

5569 (NERC-LV-539-18) RADIATION SURVEILLANCE OF RUMINANTS ON AND ABOUT THE NEVADA TEST SITE. Smith, Donald D. (National Environmental Research Center, Las Vegas, Nev. (USA)). Nov 1972. Contract AT(26-1)-539. 16p. Dep. NTIS.

The National Environmental Research Center-Las Vegas is engaged in various radiation research and surveillance activities. A portion of this work is concerned with the metabolism and tissue burdens of radionuclides in domestic and wild ruminants. The ^{90}Sr levels in bones from three species of ruminants grazing on or near the Nevada Test Site have shown a steady decline since the cessation of atmospheric testing in 1962. Levels of ^{90}Sr observed in desert bighorn sheep (Ovis canadensis nelsoni) ranged from 3.9-13.4 pCi/g of ash in 1964 (average of 9.7 pCi/g of ash) and from 1.0-12.0 pCi/g of ash in 1971 (average of 5.8 pCi/g of ash). Levels of gamma emitting radionuclides found in the Nevada Test Site beef herd remain low, with the liver as the edible organ containing the highest levels of radioactivity. In addition, the operation of an experimental dairy farm, the maintenance of an experimental beef herd, and the use of the dairy herd in controlled metabolism studies are discussed. (auth)

Plants

5570 (BNWL-1688) UPTAKE OF ^{237}Np, ^{239}Pu, ^{241}Am, AND ^{244}Cm FROM SOIL BY TUMBLEWEED AND CHEATGRASS. Price, K. R. (Battelle Pacific Northwest Labs., Richland, Wash.). Oct 1972. Contract AT(45-1)-1830. 14p. Dep. NTIS.

Tumbleweed (Salsola kali) and cheatgrass (Bromus tectorum) were grown under controlled conditions in pots containing surface soil common to radioactive waste disposal sites at Hanford. The soil was spiked with $^{237}Np(NO_3)_5$, $^{239}Pu(NO_3)_4$, $^{241}Am(NO_3)_3$, or $^{244}Cm(NO_3)_3$ solutions, and all radionuclides were absorbed by the test plants. Large amounts of neptunium were taken up (>2% dose), with smaller amounts of americium and curium. Plutonium uptake was only slight. Critical Levels of detection (L_C) are calculated, and the term Minimum Soil Detection Level (L_{MSD}) is introduced. The application of results to waste management is discussed. (auth)

5571 (EUR-4800(Vols.1 and 2), pp 1057-67) FACTORS OF TRANSFER OF ^{137}Cs FROM SOILS TO CROPS. Marckwordt, U. (EURATOM Joint Research Centre, Ispra, Italy); Lehr, J. May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

In a laboratory investigation, the available ^{137}Cs in the soil was determined as a function of the contents of clay and organic matter in the soil and expressed as a percentage of the total deposit of ^{137}Cs. Based on the available ^{137}Cs and a known content of exchangeable potassium in the soil, an estimate was made of the activity absorbed by plants under conditions of ample humidity. The transfer under these conditions of Cs from soil to plant represents an upper limit for the indirect contamination of crops that can be used to define critical levels of contamination by ^{137}Cs in different soil types. (auth)

5572 (EUR-4800(Vols.1 and 2), pp 1069-79) CONTRIBUTION TO THE STUDY OF SOIL-PLANT TRANSFER FACTORS OF ^{90}Sr, ^{137}Cs, AND ^{226}Ra. Grzybowska, Danuta; Wlodek, Stanislaw. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

In an attempt to devise means of reducing the absorption of ^{90}Sr, ^{137}Cs, and ^{226}Ra by plants growing in contaminated soil, an experiment was conducted using the following: three types of soil: sandy, podzolic, and humus; two types of radioisotope distribution in the profile: contamination at surface and at a depth of 20 cm; and two plant species: the grass, Dactilis glomerata, and the alfalfa, Medicago sativa. The results obtained made it possible to demonstrate the differences between the transfer factors for strontium, cesium, and radium released to the environment and to assess the influence of soil characteristics and tillage on the reduction of these factors. (auth)

5573 (EUR–4800(Vols.1 and 2), pp 1081-1101) DIRECT EXPERIMENTAL CONTAMINATION OF ORANGE TREES BY ^{90}Sr AND ^{137}Cs. Delmas, J.; Bovard, P.; Grauby, A.; Disdier, R.; Blondel, L.; Guennelon, R. May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

These experiments are the first in a series dealing with the relation between the environmental contamination rate and the contamination rate of citrus fruit, one of the types of fruit with the highest world consumption. This project was undertaken by the CEA in collaboration with the INRA at the San Giuliano citrus research station in Corsica. A single dose of direct contamination, using ^{90}Sr and ^{137}Cs, was administered in April 1970 on part on the aerial organs of two trees, "late Valencia" variety, in an open field. The objects of the experiments were as follows: the evolution of the foliage contamination level varying with the agricultural techniques used (watering) and the climatic conditions (precipitations); and the transference of contamination within the plants, and especially the fruit. In particular the authors seek correlations between the radionuclide content evolution on one hand, and the stable cation content on the other, during the ripening of the orange. These results, obtained in open field conditions, complete data already obtained by laboratory testing, and make it possible to determine the parts played by external influences on certain aspects of plant contamination. (auth)

5574 (EUR–4800(Vols.1 and 2), pp 1255-75) INFLUENCE OF THE QUALITY OF THE IRRIGATION WATER ON THE TRANSFER OF RADIOCESIUM AND RADIOSTRONTIUM IN IRRIGATED RICE-FIELDS. Myttenaere, C.; Mousny, J. (C.C.R., Ispra, Italy). May 1972. (In French).

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Study of the mechanisms of radiocontamination in rice-fields irrigated by submersion of the soil has emphasized the importance of the irrigation water in the transfer of the various radioelements considered (Cs, Co, and Ru). These unstable isotopes can be absorbed directly by the base of the haulm and the surface roots or may be previously fixed by the surface layer of the soil and then reabsorbed by the roots. Under such conditions, it was of interest to be able to assess the influence of the chemical properties of the water used on the level of radiocontamination of the plants, the fixing of the radioisotopes by the soil, and the elimination by the irrigation water. This problem was tackled in a "rice-field model" in which three different waters were considered: very pure (demineralized), Lake Maggiore (20 ppM Ca, 1.5 ppM K, 0.2 ppM Sr), and "charged" (100 ppM Ca, 5 ppM K, and 1 ppM Sr). These waters were doubly marked with ^{85}Sr and ^{134}Cs. During cultivation, samples of the water covering the rice-fields were taken regularly and at the end of cultivation plants and soils were sampled. The concentrations of radioelements and stable elements in the samples were determined. These results not only make it possible to establish a relation between the water used and the level of contamination of the irrigated plants, but will also enable the discrimination factors between irrigated water and plants to be calculated. These results are interpreted on a very broad basis including the water, the soil, and the plant. It is already possible to state that the water of Lake Maggiore is responsible for the highest radiocesium contamination (least fixation by the soil, low opposition in absorption). The radiostrontium content is only substantially reduced following irrigation with highly "charged" water. The distribution of the radioisotopes within the plant is also affected by the quality of the water used. The edible part (caryopsis) is the one most contaminated with Cs^+ and Sr^{++} in the case of a rice-field irrigated with water from Lake Maggiore. (auth)

5575 (EUR–4800(Vols.1 and 2), pp 1357-67) ZINC AND COBALT UPTAKE BY THE BROWN SEAWEED FUCUS SPIRALIS (L.,). van Weers, A. W. (Reactor Centrum Nederland, Petten, The Netherlands). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Radionuclides of zinc and cobalt are produced by neutron activation of corrosion products in the cooling circuit of nuclear reactors and appear often in low-level liquid waste disposed to fresh or marine waters. The stable elements zinc and cobalt are, together with other chemical pollutants of mostly industrial origin, disposed in great quantities to coastal waters. Studies of their concentration by marine organisms are of value for a better understanding of the effects of both radioactive and chemical pollution of the marine environment. In our laboratory, we have studied the uptake of zinc-65 and cobalt-60 by several coastal marine organisms. The effect of carrier concentration and chelation on the uptake by the brown seaweed Fucus spiralis is reported in this paper. A marked seasonal variation in stable zinc content of Fucus spiralis was observed in measurements covering several years. (auth)

5576 (EUR–4800(Vols.1 and 2), pp 1369-76) FIXATION OF Sr, Zn, AND Ce RADIONUCLIDES BY SODIUM ALGINATE AND ALGINIC ACID FROM SEA WATER. Lazarenko, G. E. (Inst. of Biology of South Seas, Sevastopol, USSR). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

Alginic acid is a component of brown algae content in seawater. It represents 50% of the Black Sea alga Cystoseira barbata weight and exists in all stages of its development. The acid itself is a cation-exchanger and is used to extract radiostrontium out of organisms in medicine. Sodium alginate isolated from Cystoseira is a polydispersive substance. Molecular weights of its fractions are quite different having $M_1$800,000 and $M_2$37,000. Ionic properties of both fractions are also different. Zinc is bound only by the low molecular fraction, cerium by the high molecular fraction and strontium almost equally by both fractions, i.e., probably an indication of the known strontium binding properties of alginic acid and of alginates. Cystoseira alginic acid accumulates Zn, Sr, and Ce up to concentration factor values of respectively 7, 37, and 130 units; Zn is released by alginic acid very rapidly. Nine hours after the experiment started, its content was decreased about 90%; as to Sr and Ce the decrease was only 30% and 15% correspondingly. Comparison of ^{90}Sr concentration factors and ^{90}Sr loss by alginic acid from Cystoseira and by alga itself proves the suggestions of G. G. Polikarpov and V. S. Ten (1961): this alga has some substances and structures responsible for entry and loss of radiostrontium. Researches on determination of biochemical deposition of radionuclides in marine organisms and researches on clarification of biophysical grounds for radioecological concentration processes are of important perspective in scientific and practical plan. (auth)

Microorganisms

5577 (EUR–4800(Vols.1 and 2), pp 1321-6) EXPERIMENTAL STUDY OF THE ISOTOPES ACCUMULATION BY MARINE ORGANISMS. Nazarov, A. B.; Zesenko, A. Ya. (Inst. of Biology of South Seas, Sevastopol, USSR). May 1972.

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sep 1971).

The study of natural radioactive isotopes presents a double interest from the viewpoint of radioecology: for comparison of natural and artificial radionuclides action on marine organisms; and for the study of the possible role of marine organisms in the migration of natural radioactive isotopes into the hydrosphere with the production of ore and its process. Comparatively few data are available on the biological concentration factors of Th radioisotopes. The present research aim was to study the kinetics of ^{232}Th and ^{234}Th accumulation injected into seawater in the form of oxalic and hydrochloric thorium by alga from different origin. Concentration factors for four species of alga are found experimentally. Great difference between ^{244}Th concentration factors by green and brown alga is noticed. Possible reasons of the great discrepancy between the experimental data on ^{234}Th concentration by alga from waste and literature data on the concentration of this isotope by similar alga under natural conditions are discussed. It is shown that ^{234}Th is suitable for the experimental study of Th isotopes migration in the ocean. (auth)

New Tracer Techniques

5578 (ORO–4023-4) STUDIES OF DROSOPHILA DISPERSAL AND MIGRATION BY NEUTRON ACTIVATION AND GENETIC TECHNIQUES. Progress Report, 1972. Richardson, R. H. (Texas

Univ., Austin. Dept. of Zoology). 1972. Contract AT(40-1)-4023. 74p. Dep. NTIS.

Studies on Hawaiian species of Drosophila included studies on linkage disequilibrium and population structure, development of models for studies on immigration of populations, dispersal behavior of Drosophila mimica, and habitat selection and competition in the species D. mimica, D. kambysellisi, and D. imparisetae Neutron activation tracer techniques were used in dispersal studies. The tracer elements, dysprosium, aluminum, hafnium, and manganese were applied as aqueous solutions. Experiments were initiated on the use of autoradiography for identification of labeled flies. (H.L.W.)

5579 UPTAKE OF ^{85}Sr BY HYDROXYAPATITES OF BIOLOGICAL ORIGIN. Golutvina, M. M.; Semochkina, L. S.; Kononykina, N. N. (Inst. of Biophysics, Moscow). Biol. Nauki; No. 3, 56-60(Mar 1972). (In Russian).

The kinetics of ^{85}Sr absorption from barbiturate buffer by hydroxyapatites which had been separated from bone tissues of man and rats were studied. Rapid phases of the process were completed in 4 to 6 hr in the manner of reverse ion exchange adsorption. Slow recrystallization of the bone mineral occurred, accompanied by weak capture of the isotope by the crystals. Kinetic parameters of the adsorption reaction of ^{85}Sr by the two hydroxyapatites studied were quite similar. (tr-auth) (INIS)

5580 ATLAS OF NUCLEAR MEDICINE. VOLUME 3. RETICULOENDOTHELIAL SYSTEM, LIVER, SPLEEN, AND THYROID. DeLand, F. H.; Wagner, H. N. Jr. Philadelphia; W. B. Saunders Company (1972). 304p. $21.00.

The normal anatomy of the reticuloendothelial system (including the bone marrow, liver, and spleen) and the thyroid gland is demonstrated and their reactions to disease are illustrated. The contributions of imaging to the diagnosis of diseases of these organs and the limitations of the procedures are demonstrated. One hundred and ninety six illustrations are included. (E.R.B.)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 4982, 5161, 5581, 5611, 5612, 5646, 5649, 5697, 5699, 6828, 6833, 6848, 6861, and 7150.

5581 (ORNL-4820, pp 106-39) REACTOR DEVELOPMENT SUPPORT. Sep 1972.

In Metals and Ceramics Division annual progress report for period ending June 30, 1972.

Research and development progress is reported on gas-cooled reactors, heavy-section steel technology, molten salt reactors, and thorium utilization. (J.R.D.)

5582 COALESCENCE IN TWO-PHASE ALLOYS. Nechiporenko, E. P.; Slezov, V. V.; Sagalovich, N. E.; Sagalovich, V. V.; Khrebtov, V. L. (Physical-Technical Inst., Kharkov). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 5, 1259-63(Nov 1972). Translated from Fiz. Tverd. Tela; 14: No. 5, 1469-74(May 1972).

Methods of analyzing experimental coalescence data are considered, taking the Mo–ZrO_2 system as an example. The use of the Pearson matching criterion and an analysis of the behavior of the variability coefficient in order to establish the proximity of the theoretical and experimental distribution functions with the help of an M-220 computer enables one to choose points corresponding to a single coalescence mechanism. In the later stages of the process the coalescence is excellently described by the Lifshits–Slezov theory. (auth)

5583 METHOD FOR PRODUCTION OF SiC COATINGS ON NUCLEAR FUELS OR BREEDING MATERIALS BY MEANS OF PYROLYSIS OF SEVERAL ORGANOSILICON COMPOUNDS. Drittler, K.; Luhleich, H. (to Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH). German Patent 1,571,500. 15 Jun 1972. (In German).

A method of producing SiC-coatings on nuclear fuels or breeding materials by means of pyrolysis of organo-silicon compounds at temperatures above 1,000°C is described. Halogen free organic silanes with SiC-, SiH- or Si-Si bonds are used as silicon organic compounds and the pyrolysis is carried out either in one stage or in two stages, the first of which should be at a temperature of 300 to 600°C. The pyrolysis is carried out in an inert, reducing or oxidizing atmosphere, or in a high vacuum. (GF)

5584 COATING METHOD AND DEVICE FOR FUEL PARTICLES USED IN NUCLEAR REACTORS. Wallroth, C. F.; Nickel, H.; Gyarmati, E. (to Kernforschungsanlage Juelich GmbH). German Patent 2,062,794. 22 Jun 1972. (In German).

A process for the coating of fuel particles, whose size lies between 100 μm and 1,000 μm in a fluidized bed oven, is described. In the latter, a carrier gas (e.g., argon) and a coating gas (e.g., hydrocarbon) is pulsated through a feed of fuel particles to form a fluidized bed. Through particular devices of the fluidized bed, an additional twisting movement is given which is created through a spiral forming conducted stream of carrier gas. (GF)

5585 INTERSTITIAL PHASES AS ELECTRONIC COMPOUNDS. Umanskii, Ya. S. (Moscow Inst. of Steel and Alloys). Dokl. Akad. Nauk SSSR; 204: No. 3, 664-6(21 Mar 1972). (In Russian).

Crystal structure and alloy phase diagrams are discussed relative to the generalizations of G. Hagg (1931), and W. Hume-Rothery (1926) concerning phase intrusion, lattice types, metallic compounds, and electron configuration of transition metals such as Zr, Nb, Mo, Ru, Rh, Hf, Ta, W, Re. Their hydrides, carbides, oxides, and nitrides serve as examples in the discussion. (K.S.W.)

5586 MECHANISM OF FLUORITE-LIKE SOLID SOLUTION DECOMPOSITION IN THE SYSTEMS ZrO_2–MgO AND ZrO_2–MgO–Y_2O_3. Tikhonov, P. A.; Kuznetsov, A. K.; Keler, E. K.; Kuznetsova, S. N.; Udalov, Yu. P. (Inst. of Silicate Chemistry, Leningrad). Dokl. Akad. Nauk SSSR; 204: No. 3, 661-3(21 Mar 1972). (In Russian).

Phase, structure, and concentration relationships were studied in the breakdown of solid solutions in the systems ZrO_2–MgO, and ZrO_2–MgO–Y_2O_3. Fluorite-like solid solutions of ZrO_2 + 16 mole % MgO, with and without additions of various quantities of Y_2O_3 (0.8, 2.0, and 7 mole %) were synthesized from the oxide mixtures at 1900°C in a He atmosphere, and subsequently chilled and annealed. Separation curves of free MgO from the solid solution at 1200° showed two stages: MgO separation from a cubic structure, and further MgO separation causing a transition of the solid solutions from cubic to tetragonal. The effects of varying the Y_2O_3 content on this mechanism are discussed. (K.S.W.)

5587 PHASE TRANSITIONS IN URANIUM OXIDES. Spitsyn, Vikt. I.; Tsvigunov, A. N.; Kovba, L. M.; Kuz'micheva, E. U. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 204: No. 3, 640-3 (21 Mar 1972). (In Russian).

Phase compositions were studied in uranium oxides in the region $UO_{2.50}$ to $UO_{2.67}$. Reduction of single crystals of various available U oxides yielded the following compounds: $U_{11}O_{29}$, U_8O_{21}, $U_{13}O_{34}$, and δ-U_2O_5. Lattice parameters and suggested Federov groups are tabulated for these and other oxides, including a new α''-U_3O_8 never previously described. (K.S.W.)

5588 FABRICATION PROCESS FOR URANIUM MONOCARBIDE OF URANIUM MONONITRIDE NUCLEAR FUELS. Krauth, A. (to Nuklear-Chemie und -Metallurgie GmbH). German Patent 2,055,686. 18 May 1972. (In German).

A fabrication process of a nuclear fuel from uranium monocarbide of uranium mononitride respectively by carboreduction is given. It is characterized by the fact that the carboreduction is broken off before the end (when 50 to 95%, in particular 70 to 90% of the starting material has been converted) and the resulting material is ground, pressed and reaction sintered. The resulting carbide powder or nitride powder respectively, is inactivated by chemical substances. (GF)

5589 CALCULATION OF SOLUBILITY LIMITS IN SOLID STATE IN CRYSTALS WITH THE STRUCTURE OF Tl_2O_3 TYPE. Ogorodnikova, A. A.; Lopato, L. M. (Inst. of Problems in Material Studies, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 6, 542-5(1972). (In Russian).

A simple, sufficiently precise semiempirical method is proposed to calculate solubility limits in ionic crystals with the structure of Tl_2O_3 type from solid-solution-lattice and solvent-lattice parameters. The method is based on the ideality and additivity postulates. The suggested equations may be considered as a modified expression of the Vegard law for a case of molecular substitution; the structure of the solvent and solved substance may be different. The suggested method is effective not only for isovalent substitution but also for the cases of heterovalent substitution when defects are formed in cation and anion sublattice. Main applications of the method are for the calculation of solubility limits and effective radius of vacancies. Calculations conducted for a number of oxide systems are in good agreement with experimental data. (auth)

5590 DESIGN AND CONSTRUCTION OF A DEVICE FOR CONTINUOUS MEASUREMENTS OF CREEP IN URANIUM CARBIDE UNDER IRRADIATION. De Vita, F. (Politecnico, Turin); Merlini, C.; Zeisser, P. Energ. Nucl. (Milan); 19: No. 11, 676-83(Nov 1972). (In Italian).

A device has been designed and constructed, which allows continuous x measurement of creep in a uranium carbide hollow tube specimen, under axial compression, neutron irradiation and high temperature conditions. Neutron distribution and thermal-mechanical stress distribution have been calculated in order to either check the system security or determine test parameters which affect creep: i.e., temperature, stress, and fission density. They may be varied in a fairly wide range. Preliminary tests confirmed the functionality of the device components. (auth)

5591 NUCLEAR FUELS MADE OF URANIUM–PLUTONIUM–CARBIDE OR URANIUM–PLUTONIUM NITRIDE, RESPECTIVELY. Krauth, A.; Mueller, N. (Nuklear-Chemie und -Metallurgie GmbH). German Patent 2,049,573. 15 Jun 1972. (In German).

The production process of nuclear fuel from uranium-plutonium carbide or uranium-plutonium nitride is described. It is thus characterized by the fact that the fertile material (uranium-carbide nitride) and the fuel (plutonium-carbide nitride) regions are separated, and that the fuel regions have a higher and more open porosity than the fertile material region, and that the fuel particles are coated with a fuel nitride layer. (GF)

5592 PHASE COMPOSITION DIAGRAM FOR THE SYSTEM Pr_2O_3–CaO. Lopato, L. M.; Lugin, L. I.; Shevchenko, A. V. Zh. Neorg. Khim.; 17: No. 9, 2543-5(Sep 1972). (In Russian).

The phase composition diagram was constructed for the system Pr_2O_3–CaO in the temperature range 1,500 to 2,350°C. The existence of a new β-phase near the composition 2:1 was detected above 1,925°C, and a region of solid solutions of the original oxides was established. CaO raised the transition temperature of two polymorphic forms of Pr_2O_3. (tr-auth)

5593 RELATIONSHIP OF CRYSTAL GROWTH PARAMETERS TO THE STOICHIOMETRY OF EuO AS DETERMINED BY I. R. AND CONDUCTIVITY MEASUREMENTS. Shafer, M. W.; Torrance, J. B.; Penney, T. (IBM Watson Research Center, Yorktown Heights, NY). J. Phys. Chem. Solids; 33: No. 12, 2251-66(Dec 1972).

Single crystals of EuO were grown from melts containing excess Eu metal. Infrared absorption and conductivity measurements were made on these crystals and the results correlated with the crystal growth parameters. It is seen that as the concentration of europium in the initial melt is increased, the growth temperature is lowered and the crystals become richer in europium. The variations in the ir absorption and conductivity were studied and are shown to be strongly related to composition. According to the ir and conductivity behavior, the EuO crystals can be classified into five types, with compositions ranging from oxygen-rich, to stoichiometric, and to europium-rich. The oxygen-rich EuO crystals are insulators and exhibit ir absorption which is attributed to Eu_3O_4 and to Eu^{3+}. Ony weak ir absorption is seen in the stoichiometric crystals. Those with a deficiency of oxygen show a new ir absorption and have either metallic conduction or show large insulator–metal transitions which are attributed to oxygen vacancies. A new phase diagram was constructed which can be used as a guide for growing EuO crystals. Several crystal growing methods are also discussed. (auth)

5594 TOPOTACTIC DEHYDRATION OF MOLYBDENUM TRIOXIDE HYDRATES. Guenter, John R. (Univ., Zurich). J. Solid State Chem.; 5: No. 3, 354-9(Nov 1972).

It is shown that thermal dehydration of molybdenum trioxide dihydrate proceeds in two steps, both of which are strongly topotactic. The topotactic relations were established and used to propose a structure model for the intermediate product, molybdenum trioxide monohydrate, the unit cell of which was determined. The guiding elements of the two topotactic reactions are planes of corner-sharing octahedra. The conservation of these planes throughout the reactions is confirmed by scanning electron micrographs in addition to the results of x-ray diffraction. (auth)

5595 SIZE GRADING OF ARTICLES. Lefevre, R. L. R. (to United Kingdom Atomic Energy Authority). British Patent 1,287,193. 31 Aug 1972. Filed 15 Jan 1970.

It is stated that sieving as a method of grading materials has drawbacks, some of which have come to light in the size grading of small spheroids of nuclear fuel. An improved technique is described, particularly applicable to the nuclear fuel industry, and suitable for articles whose shape is such as to allow a row of the articles to present a common linear dimension to a spaced gaging surface. The articles are guided into an open-topped channel whose base has an aperture defined by gaging surfaces spaced apart to permit the passage through the aperture of articles below a given size; the channel is then tilted to eject any articles retained therein by the gaging surfaces. The articles may be guided into the channel to engage the gaging surfaces simultaneously and the channel then rotated, to eject articles, about an axis parallel to but lying outside the channel. Reciprocating means may be provided to free any articles jammed between the gaging surfaces. (UK)

5596 NEUTRON IRRADIATION, STRESS GRADIENTS, AND KIRKENDALL SHIFTS. Hesketh, R. V. (Central Electricity Generating Board, Berkeley, Eng.). Radiat. Eff.; 16: No. 1-2, 141-2(Sep 1972).

Commenting on a previous publication (Mosedale, Rad. Effects; 14: 287 (1972)) it is suggested that stress gradients in a crystal produce Kirkendall shifts; not creep. It is also suggested that the difference of opinion stems from thinking about the divergence of lattice defects rather than the flux itself, and that it would be wrong to conclude that though the force on the defects is along the stress gradient, the resulting drift velocity has a component across the stress gradient. The Nernst–Einstein relation, applicable to the diffusion of lattice vacancies and interstitial atoms, states that the drift velocity, v, is proportional to the applied force F, the constant of proportionality being the mobility, μ: $v = \mu F$. In this relation, v and F are vectors. If μ is a scalar, v is always parallel to F. The component of v across the stress gradient, $F = -\nabla E$, is zero. It is considered that there is nothing in the previous publication to suggest that μ is other than scalar. The flow of defects, created at a steady state by neutron irradiation, through a volume element of a crystal, is discussed in more detail. (UK)

5597 ELECTRIC CONDUCTIVITY OF IRRADIATED AND UNIRRADIATED OXIDE FORMS OF IRON-PROMOTED CATALYSTS. Spitsyn, V. I.; Erofeev, B. V.; Mikhailenko, I. E.; Chikhladze, V. V. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 204: No. 1, 151-3(1 Mar 1972). (In Russian).

The oxide forms of promoted iron catalysts for ammonia synthesis were irradiated in a reactor with neutrons for 5 h in a flux of 1.2×10^{12} n/cm^2 · sec. The specific electric conductivity of irradiated and unirradiated samples were measured as functions of the reciprocal temperature. The limiting electric conductivity curve, reached after repeated annealing and conductivity measurements, was higher for irradiated catalysts than for unirradiated. (K.S.W.)

5598 EFFECT OF ATMOSPHERE ON THE SINTERING OF URANIUM DIOXIDE IN THE TEMPERATURE RANGE 900 TO 1200°C. Kostic, E.; Petrovic, V.; Ristic, M. M. (Boris Kidric Inst. for Nuclear Physics, Belgrade). Sprechsaal Keram. Glas Email Silikate; 104: No. 24, 1081-4(1971).

Pressed UO_2-powder samples have been sintered at temperatures of 900, 1,000, 1,100, and 1,200°C, respectively in dry hydrogen, helium, and vacuum. The sintered samples have been characterized by measuring of porosity, shapes and sizes of pores and grains, and by studying the types of fracture surface. The atmosphere of sintering had a crucial effect on the formation of definite porosity type in pellets of uranium dioxide. A discussion is given on the effects of the U/O ratio on the densification process and on the obtained values of diffusion coefficients of U^{4+}-ion. (I Hoe) (GF)

5599 IRON–MOLYBDENUM OXIDE CATALYST FOR THE CONVERSION OF METHANOL TO FORMALDEHYDE. III. MOESSBAUER SPECTRA. Bartenev, G. M.; Boreskov, G. K.; Zakirov, R. R.; (and others) (Inst. of Catalysis, Novosibirsk, USSR). Kinet. Katal.; 13: No. 1, 240-3(1972). (In Russian).

The nature of the compounds formed in the Fe–Mo–O system at temperatures up to 600°C and as a result of varying the Mo/Fe ratio from 1.0 to 2.5, were studied. Fe entered into combination with Mo over most of this temperature range; calcination at 600°C formed iron molybdate. With a surplus of Fe, a coarse crystalline phase of Fe_2O_3 formed in addition to the iron molybdate. Moessbauer spectra were used to characterize the catalyst preparations. (tr-auth)

5600 FLUID-BED PROCESS FOR THE CONVERSION OF U/Pu NITRATES TO OXIDES. Levitz, N.; Grosvenor, D.; Vogler, S.; Teats, F. G. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 667(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5601 STUDIES OF DIFFUSION IN SOLIDS USING ALPHA-PARTICLE SPECTROMETRY. Martinez, A. M.; Mulas, P. (Instituto Nacional de Energia Nuclear, Mexico City). Trans. Amer. Nucl. Soc.; 15: No. 2, 713(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5602 THERMAL CONDUCTIVITY OF BORON CARBIDE PELLETS. Mahagin, D. E.; Baker, D. E. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 740(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5603 EVALUATION OF FAST-REACTOR-IRRADIATED BORON CARBIDE PELLETS. Copeland, G. L.; Donnelly, R. G. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 740-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5604 MICROSTRUCTURE OF FAST-REACTOR-IRRADIATED BORON CARBIDE. Cummings, W. V.; Laidler, J. J.; Mahagin, D. E.; Mastel, B. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 742(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5605 INSTRUMENTED IRRADIATION OF BORON CARBIDE IN A SPECTRUM-HARDENED ETR FLUX. Pitner, A. L. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 742-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5606 MIXED-OXIDE FUEL MICROSTRUCTURAL DATA SUGGESTING MODIFICATION OF THE THREE-REGION MODEL. Hilbert, R. F.; Black, T. J.; Rubin, B. F.; Stephen, J. D. (General Electric Corp., Sunnyvale, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 750-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5607 ANALYSIS OF URANIUM AND PLUTONIUM MIGRATION IN IRRADIATED MIXED-OXIDE FUELS. Meyer, R. O.

(Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 753-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5608 THERMOELECTRIC, RESISTANCE, AND ULTRASONIC CENTERLINE THERMOMETRY FOR A (U,Pu)O_2 FUEL PIN. Shepard, R. L.; Fitts, R. B.; Robertson, H. E.; Hyland, R. F. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 766-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5609 EXISTENCE AND STRUCTURE OF GADOLINIUM AND SAMARIUM MONOXIDES AND THEIR RELATED LOWER OXIDES. Bist, B. M. S.; Kumar, J.; Srivastava, O. N. (Banaras Hindu Univ., India). Phys. Status Solidi (a); 14: No. 1, 197-206(16 Nov 1972).

The monoxides of the rare earth metals may be "n" or "p" type semiconductors. The investigation describes the existence and structural crystallography and defect substructure of gadolinium and samarium monoxides and of their reduced variants. The gadolinium and samarium monoxides were prepared in the form of thin films and were found to have zinc-blende-type structures with lattice parameters equal to (5.24 ± 0.05) Å and (5.15 ± 0.05) Å respectively. Annealing of the original material resulted in the formation of superlattices and accompanying domain substructures. The superlattices as described on hexagonal axes have rhombohedral unit cells with lattice parameters $a_R = 2a_c\sqrt{2}$ and $c_R = 2a_c\sqrt{3}$ (a_c being the lattice parameter of the fundamental zinc sulfide-type unit cell). Structure analysis of the superlattices was carried out and it was found that the superlattices are formed by the ordered arrangement of oxygen vacancies in the parent lattices. The nonstoichiometric variants are of the form RO_x where R = Gd, Sm and x = 0.656. (auth)

5610 RECENT DEVELOPMENTS IN THE PREPARATION OF SPECIMENS BY SPUTTER THINNING. Barber, D. J. (Univ. of Essex, Eng.). pp 302-3 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From fifth European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

One of the prime requirements for a satisfactory thin foil for use in transmission electron microscopy is that it should contain several square microns of uniformly thin material characteristic of the bulk, and sputter thinning can yield usable foils of most nonmetallic materials, but there is still some doubt concerning the best way to minimize creation of irregularities in the foil surfaces. Local variations of thickness are likely to be troublesome in the case of multiphase materials with a coarse microstructure, and the effect of rotation during ion erosion is to generate rounded off hummocks and also craters. In an attempt to ascertain how such irregularities arise, the development of surface relief during the bombardment of fused silica glass was studied, with particular regard to "hummocks." Amongst other things it was noted that traces of impurities can enhance the development of surface structures on individual crystallites; this was particularly noted in the case of Al_2O_3 + 0.04% MgO + 0.06% ThO_2 and Al_2O_3 + 0.04% MgO + 0.06% Yb_2O_3. (UK)

Metals and Alloys

Refer also to abstract 5412.

5611 (ORNL-4820) METALS AND CERAMICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1972. Peterson, Sigfred (comp. and ed.) (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 207p. Dep. NTIS.

Research progress is reported in six sections. A separate abstract was prepared for each section. (J.R.D.)

For abstracts of individual sections see: 5581, 5612, 5649, and 5697-5699.

5612 (ORNL-4820, pp 1-37) FUNDAMENTAL PROGRAMS. Sep 1972.

In Metals and Ceramics Division annual progress report for period ending June 30, 1972.

Research and development progress is reported on crystal physics, deformation of crystalline solids, diffusion in solids, electron microscopy, properties of ceramics, physical metallurgy, superconductors, surface phenomena, theoretical solid state physics, and x-ray diffraction analysis. (J.R.D.)

Corrosion and Erosion

Refer also to abstracts 5016 and 5017.

5613 (KFK-1618) PROGRESS REPORT ON FISSION PRODUCT CONTROL, ANNUAL, 1971. (Kernforschungszentrum, Karlsruhe (West Germany)). [nd]. 243p. (In German). Dep. NTIS (U. S. Sales Only).

Results of studies on the project fission product control are reported that were conducted during 1971 by the society for nuclear research at Karlsruhe and the European institute for transuranium elements as well as by several industrial corporations. The topic is treated under the main headings of: system analysis, nondestructive test methods; direct methods; measures for containment; experimental examination of monitoring procedures; studies for monitoring procedures in nuclear installations; and international cooperation. (H.B.G.)

5614 (ORNL-4782, pp 108-202) MATERIALS DEVELOPMENT. Oct 1972.

In Molten-Salt Reactor Program.

ANTIMONY — effects of additions of, on mechanical properties of Hastelloy N
ARSENIC — effects of additions of, on mechanical properties of Hastelloy N
BERYLLIUM FLUORIDES — BeF_2-LiF-UF_4, corrosive effects on Hastelloy N at high temperatures
— BeF_2-LiF-UF_4-ZrF_4, corrosive effects on tubes of Inor-8 and Hastelloy N at high temperatures
BISMUTH ALLOYS AND SYSTEMS — Bi-base-Li, compatibility with graphite and T-111 alloy at 700°C
CADMIUM — effects of additions of, on mechanical properties of Hastelloy N
CARBON — properties of pyrolytic, for sealing graphite pores
CESIUM — effects of additions of, on mechanical properties of Hastelloy N
CROLOY — corrosion by steam at 538°C
FISSION PRODUCTS — effects of gaseous, intergranular cracking of Hastelloy N, Inor-8, and Type 304L stainless steel
GRAPHITE — corrosion by MSRE blanket and fuel salts, research program on
— development for extended reactor life, research program on
— permeability of reactor-grade, measurement of
— microstructure of reactor-grade
— compatibility with bismuth containing trace lithium at 700°C
HASTELLOY N — corrosion by MSRE blanket and fuel salts, research program on
— cracking of stressed specimens of, at 650°C, effects of tellurium vapor on
— cracking of stressed specimens of, effects of gaseous fission products and sulfur on
— mechanical properties of, effects of alloying additions on
— mechanical properties of titanium-modified
— microstructure of titanium-modified
— corrosion by steam at 538°C
INCOLOY 800 — properties for use in duplex steam generator tubing with Nickel 280
INOR-8 — corrosion by MSRE salts at high temperatures
MOLTEN SALT REACTOR EXPERIMENT — components for, evaluation of stability of
MOLYBDENUM — fabrication of test columns of, for molten salt reactor fuel processing
NICKEL 200 — cracking of stressed specimens of, effects of gaseous fission products and sulfur on
NICKEL ALLOYS AND SYSTEMS — properties of Type 280, for use in duplex steam generator tubing with Incoloy 800
RUTHENIUM — effects of additions of, on mechanical properties of Hastelloy N
SELENIUM — effects of additions of, on mechanical properties of Hastelloy N
SODIUM FLUOROBORATES — $NaBF_4$-NaF, corrosive effects on Hastelloy N at 454 to 620°C
STAINLESS STEEL — cracking of stressed specimens of, effects of gaseous fission products and sulfur on
STEAM — corrosive effects on Croloy and Hastelloy N at 538°C
STRONTIUM — effects of additions of, on mechanical properties of Hastelloy N
SULFUR — effects of gaseous, intergranular cracking of Hastelloy N, Inor-8, and Type 304L stainless steel
— effects of additions of, on mechanical properties of Hastelloy N
T-111 (TANTALUM ALLOY) — compatibility with bismuth containing trace lithium at 700°C

TECHNETIUM — effects of additions of, on mechanical properties of Hastelloy N
TELLURIUM — effects on cracking of stressed Hastelloy N at 650°C
— effects of additions of, on mechanical properties of Hastelloy N
TIN — effects of additions of, on mechanical properties of Hastelloy N
VALVES — stability of MSRE FV 105, evaluation of (J.R.D.)

5615 (SC-RR-720699) OXIDATION CHARACTERISTICS OF A QUINARY URANIUM ALLOY. Boultinghouse, K. D.; Sallach, R. A. (Sandia Lab., Albuquerque, N. Mex.). Oct 1972. 13p. Dep. NTIS.

The oxidation of a uranium alloy (nominal composition: 0.6 wt % Mo, 0.6 wt % Zr, 0.5 wt % Nb, 0.5 wt % Ti, balance U) was studied at 300 and 400°C in oxygen at pressures of 1 and 10 torr. Parabolic reactions were found for all conditions except for the aged metal at 400°C. There the reaction curves were "S" shaped and exhibited "breakaway" rates. Oxidation of either of the alloy states is faster than that of the corresponding states of uranium alloys containing either 6 or 8 wt % Nb. (auth)

5616 MECHANICAL PROPERTIES OF TITANIUM REINFORCED WITH UNIDIRECTIONAL MOLYBDENUM WIRES. Karpinos, D. M.; Tuchinskii, L. I.; Gorb, M. L.; Umanskii, E. S.; Fefer, V. Ya. Probl. Prochnosti; No. 6, 28-32(1972). (In Russian).

A study on the mechanical properties of reinforced titanium-based materials is presented. Compositions based on type VT-1-0 alloy reinforced with unidirectional M4 molybdenum wires were used. The specimens were made by vacuum dynamic hot pressing. The volumetric content of wire was adjusted by the winding step and amounted to 10, 20, 32, and 44 vol %. Each specimen consisted of 20 to 30 plates with wound wires. The dependence of tensile strength, yield point, $\sigma_{0.2}$, Young modulus, and impact toughness on molybdenum content was studied. It was found that the tensile strength and modulus of elasticity of compositions increased linearly with increasing volumetric content of wire, which agrees with the additive rule. It was demonstrated that as temperature rises, the strengthening factor of the compositions increases significantly. Impact toughness was found to be dependent on composition and orientation of reinforcing elements. (JPRS)

5617 CONFERENCE CYCLE ON CHEMISTRY OF WATER AND AQUEOUS CORROSION IN STEAM GENERATORS (CONVENTIONAL AND NUCLEAR). Conference Held at Ermenonville, France, March 13, 1972. Ecuelles, France; Electricite de France (1972). vp. (In French and English). (CONF-720323).

Fourteen papers were abstracted for NSA. The main topics studied are: choice of materials for vapor generators, liquid vapor-flow, chemistry of water and solutions at high temperatures for application to corrosion in power systems, nuclear water chemistry, oxidation mechanism of steels in water at high temperature and the formation of oxide deposits, corrosion tests in the operational maintenance of nuclear vapor generators, transport and radioactivation of corrosion products in the primary water circuits of a reactor, corrosion of zircaloy cladding in pressurized water reactors, stress corrosion of austenitic steels and alloys in water circuits used for energy production, stress corrosion behavior of Fe–Ni–Cr alloys in high temperature water, ferritic and austeno-ferritic stainless steels resisting to stress corrosion, mixed bed treatment of condensates, and treatment of condensates on powdered resin filters. (France)

For abstracts of individual papers see: 5016, 5017, 5154, 5155, 5189, and 5618–5626.

5618 CORROSION TESTS IN THE OPERATIONAL MAINTENANCE OF CONVENTIONAL AND NUCLEAR VAPOR GENERATORS. Geffroy, B.; Donati, J. R. (Electricite de France, Ecuelles). 7p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972). (In French).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

The validity of the 1st, 2nd and 3rd generation tests on the material, and test conditions are examined. These conditions enable the best possible simulation of phenomena occurring in operation to be effected with the test installation. As the test period can not exceed 20,000 hours, certain results have to be extrapolated and certain processes accelerated. An installation for studying the vapor generator tubes of PWR is presented. (France)

5619 STRESS CORROSION RESISTANT FERRITIC AND AUSTENO-FERRITIC STAINLESS STEELS. Hochmann, J.; Desestret, A. (Societe Creusot-Loire, Paris). 10p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972). (In French).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

Austeno-ferritic steels having the following properties are used in the chemical and nuclear industry: very good mechanical properties, good resistance to intergranular corrosion and stress corrosion. The structure and phase transformations of these alloys are reviewed, together with the manufacture of molded parts. Ferritic alloys containing 17 to 30% Cr have been developed. Such alloys compromise between corrosion resistance and ductile properties. (France)

5620 CHOICE OF MATERIALS FOR VAPOR GENERATORS. Teraube, R. (Societe Francaise des Constructions Babcock et Wilcox, Paris); Vigneron, G. 11p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972). (In French).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

Materials used in vapor generators require high chemical resistance to boiling water, flames and the coolant fluid. The material used must also possess sufficiently good mechanical properties. The principal steels used are presented: nonalloyed C steel, weakly alloyed steels, alloyed steels (ferritic chromium steels, austenitic steels, and alloys containing large quantities of Ni), and steels for vapor generators in which the heating fluid is particularly corrosive (liquid Na or gas). Alloys having high Ni contents (INCONEL type) are used in nuclear vapor generators heated by pressurized water. (France)

5621 APPLICATION OF MECHANICAL RUPTURE TECHNIQUES TO STRESS CORROSION TESTS WITH AUSTENITIC ALLOYS. Bui, H. D.; Donati, J. R.; Menar, A.; Valibus, L.; Villard, D. (Electricite de France, Ecuelles). 16p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972). (In French).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

The slow fissuration of stressed austenitic alloys in light water reactors was studied using rupture mechanics. In this way, the manner in which existing or new defects are propagated in structure was established. A fatigue fissured transverse test bar of known theoretical characteristics was developed. The stress at the bottom of the fissure can be defined by a coefficient K. The types of transverse test bar presented have been tested in pressurized water reactor. (France)

5622 SOME INVESTIGATIONS INTO THE STRESS CORROSION BEHAVIOR OF Fe–Ni–Cr ALLOYS IN HIGH TEMPERATURE WATER. Flint, G. N.; Weldon, B. A. 17p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

Discrepancies exist between the results obtained from stress-corrosion tests, undertaken at various laboratories, on alloy 600 exposed to high-purity water at about 300°C. While certain laboratories observed severe cracking within periods up to 7000 hours, others were unable to reproduce such failure even after longer durations. In an effort to define conditions in which cracking might be reproduced, tests were carried out in which contaminants were introduced into the test environments: lead, aerated water. Recent studies of the behavior of nickel–chromium–iron alloys exposed to such contaminated waters demonstrate that with progressive increase in chromium content, improved resistance to stress corrosion cracking is obtained. (France)

5623 PROBLEMS ARISING FROM THE STRESS CORROSION OF AUSTENITIC STEELS AND ALLOYS IN WATER CIRCUITS USED FOR ENERGY PRODUCTION. Coriou, H.; Grall, L. (CEN, Fontenay-aux-Roses, France). 25p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972). (In French).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

Alloys with high Ni contents such as Inconel 600 are used to construct the tubes of steam generators. Stainless steels (18% Cr, 10% Ni) are used for the collectors and to join the collectors to the pressure vessel. It was observed that intergranular fissuration can result from excessive stresses in the structure (large temperature gradients, corrosive media). The different observations demonstrate that it is favorable to use steels with very low C contents, austeno-ferritic steels, or alloys having an average Ni content. (France)

5624 OXIDATION MECHANISM OF STEELS IN WATER AT HIGH TEMPERATURE AND THE FORMATION OF OXIDE DEPOSITS. Berge, P. (Electricite de France, Ecuelles). 35p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972). (In French).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

Two mechanisms are proposed to explain the principal experimental results: the Schikorr reaction; the double layer theory. These mechanisms in conjunction with recent work on the reversibility of the Shikorr reaction in the presence of hydrogen enabled a new model to be proposed. This model predicts the behavior of steels in relation to the temperature conditions, pH value, speed of the circulating water, state of the surface, and presence of oxygen. The model enables the mechanisms concerned in the formation of deposits from the metal in solution, or oxides in solution to be explained. Vapor corrosion mechanisms were also studied. (France)

5625 TRANSPORT AND RADIOACTIVATION OF CORROSION PRODUCTS IN THE PRIMARY WATER CIRCUITS OF A REACTOR. Brisbois, J.; Dolle, L. (CEN de Saclay, Gif-sur-Yvette, France). 38p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972). (In French).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

The problems arising from the radioactive corrosion products produced during the operation of pressurized water reactors are considered: activity of the circuits at shutdown; activity of the water during discharging operations. The nuclear processes involved in the formation of radioactive nuclides in the primary circuits are described. A qualitative description of the phenomena associated with the transfer of the products in the circuit is given: release into the fluid; deposits in the stainless steel circuits; chemical mechanisms induced by the effect of ionizing radiations; the recirculation of corrosion products deposited in the core. A model for calculating the properties of the corrosion products is presented. Some results obtained for a pressurized water power reactor are given. (France)

5626 CORROSION OF ZIRCALOY CLADDING IN PRESSURIZED WATER REACTORS. Octors (Societe Franco-Americaine de Constructions Atomiques, Courbevoie, France); Traccucci; Verdoni; Serole. 80p. of Conference Cycle on Chemistry of Water and Aqueous Corrosion in Steam Generators (Conventional and Nuclear). Ecuelles, France; Electricite de France (1972). (In French).

From Conference cycle on chemistry of water and aqueous corrosion in steam generators; Ermenonville, France (13 Mar 1972). See CONF-720323.

The fuel assemblies and the operational characteristics of pressurized light water reactors are presented. The performance obtained from the fuel elements is given. Corrosion and internal and external formation of hydride on the Zircaloy cladding are described. The effect of the chemical action of water, irradiation, the thermal flux, and the surface state of the pins on the corrosion kinetics was studied. The consequences of the corrosion and the hydride formation on the mechanical properties of the claddings were studied. The manufacture of the fuel pins is discussed. Corrosion tests and tests on the internal and external hydride formation were carried out. The principal manufacturing techniques adopted in view of corrosion control are described. (France)

5627 CHEMICAL REACTIONS AND METALLIC MATERIALS. Yukio, Okura. Haikan To Sochi; 10: No. 10, 4-10 (1970). (In Japanese).

The use of various structural materials in the chemical industry, including alloys based on Ni, Zr and Ti, stainless Cr–Ni steel, etc. is discussed. The most common types of corrosion are noted, also the main aggressive media, including alkalis, acids, salts and various gases are reviewed. (Referativnyi Zh.)

5628 EFFECT OF OXYGEN ON THE CORROSION OF NIOBIUM AND TANTALUM BY LIQUID LITHIUM. Klueh, R. L. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 746-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5629 PROTECTION OF MOLYBDENUM AND TUNGSTEN FROM CARBURIZATION. Evtushok, T. M.; Zhunkovskii, G. L. Fiz. Khim. Obrab. Mater.; No. 4, 108-12(1972). (In Russian).

Diffused boride layers on Mo and W were tested as "barriers" against carburization by graphite and lamp black at temperatures up to 2,000°C. The interaction of the boride layers with the supporting metal; the use of the boride "barriers" toward carburization is limited by such boride-metal reactions at elevated temperatures. (K.S.W.)

Preparation and Fabrication

Refer also to abstracts 5056, 5146, 5413, 5581, and 5595.

5630 PECULIARITIES OF THE FORMATION OF THIN TANTALUM FILMS PREPARED BY CATHODE SPUTTERING. Umanskii, Ya. S.; Urazaliev, U. S.; Ivanov, R. D. (Moscow Inst. of Steel and Alloys). Fiz. Metal. Metalloved.; 33: No. 1, 196-9(Jan 1972). (In Russian).

The features of thin Ta films obtained by cathode sputtering in a glow discharge at 10^{-2} mm Hg were studied. A volatilized film was found to be α–Ta + TaC; the composition of a cathode-deposited film was much simpler: with a thickness of 600 Å, β-phase; thicker films were β-phase + α–Ta; in films 1,500 to 2,000 Å thick, only α–Ta was found. The axes of these crystallites are discussed, and electron microphotographs are explained. The maximum energy of the sputtered atoms (8 eV) and the potential of the target (50 to 200 eV) are contrasted. (K.S.W.)

5631 CRACKING OF ZIRCALOY AS A RESULT OF UNUSUAL LOCALIZED TEXTURING. Evans, W. M.; Gessner, R. F.; Goodwin, J. G. (Westinghouse Electric Corp., West Mifflin, Pa.). Met. Trans.; 3: No. 11, 2879-87(Nov 1972).

Microcracks in rolled Zircaloy have been observed at an angle of 35° to the plate normal in relatively fine-grained bands within a matrix of coarser grains. The fine-grained regions show a different crystallographic orientation than the matrix when observed under polarized light. This duplex "crack-prone" structure results from a rolling schedule of many light passes. A fewer number of heavier passes alleviates the problem. Starting with a single Zircaloy ingot, thermomechanical processing is varied according to three different schedules: light, normal, and heavy reductions per rolling pass. Samples obtained at several stages during each of the three rolling schedules are examined for crystallographic texture and fatigue strength. A computer program is used to generate inverse pole figures, histograms of basal pole inclination vs volume percent of grains and f numbers from X-ray diffraction data. The f numbers define the effective fraction of basal poles aligned in the directions of interest. These results are used to illustrate the texture changes and their influence upon the cracking sensitivity of Zircaloy during the various stages of reduction, and thermal treatments of the three rolling schedules. A significant effect on cracking sensitivity due to hot and cold rolling pass schedules is shown, and a tendency for light hot rolling passes to align basal poles normal to the rolling plane is demonstrated. (auth)

5632 OBSERVATION OF THE EFFECT OF GRAIN STRUCTURE ON THE APPEARANCE OF KIRKENDALL POROSITY. Whittenberger, J. D. (Lewis Research Center, Cleveland, Ohio). Met. Trans.; 3: No. 11, 3038-40(Nov 1972).

The effect of grain structure on the appearance of Kirkendall porosity in Ni–20Cr–2ThO_2: Ni type diffusion couples was studied. Comparison of Kirkendall porosity in the diffused couples with prior grain structure studies on the alloys showed that the absence of Kirkendall porosity in some of the couples was structure-related. (T.F.D.)

5633 PROCESS FOR COATING OF FUEL ELEMENT CANS. Michael, I. (to Gesellschaft fuer Kernforschung mbH). German Patent 2,059,672. 8 Jun 1972. (In German).

A process for coating of fuel element cans, in which the coating material is sprayed onto the base layer, having the same or a similar lattice structure as the coating, using a modified cathode

spray on the still well-known metal spray process is described. Then a heat treatment follows, which gives use to diffusion between the base layer and the new coating, whereby coherent transitions can be formed between the two layers. (GF)

5634 FROM CONCENTRATES TO URANIUM METAL. Energ. Nucl. (Madrid); 16: No. 77, 291-4(1972). (In Spanish).

The activity of the JEN in the production of uranium metal from concentrates is briefly outlined. (J.S.R.)

5635 FABRICATION CONTROL. Gonzalez, Garcia, V.; B Belda, R. M. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 16: No. 77, 369-78(1972). (In Spanish).

The controls exercised during the purification of concentrates, production of uranium compounds, and production of the ingot are briefly summarized. Factors which make it possible to estimate the limits attainable in future installations are discussed. (J.S.R.)

5636 NUCLEAR QUALITY AND SPECIFICATIONS. San Segundo, T.; Anca, R. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 16: No. 77, 355-8(1972). (In Spanish).

The concept of nuclear purity is defined and its importance is indicated. Specifications established for the production of uranium are tabulated and briefly discussed. (J.S.R.)

5637 PREPARATION OF Be–Ca ALLOYS BY ELECTROLYSIS IN BATHS CONTAINING MOLTEN SALTS. Boisde, G.; Broc, M.; Chauvin, G.; Schaub, B. (CEN, Fontenay-aux-Roses, France). Metaux (Corros.-Ind.); 47: No. 562, 205-9 (Jun 1972). (In French).

Electrolysis in molten salt media ($CaCl_2-CaF_2$) eutectic is discussed. It was demonstrated that Ca deposits can be formed on Be and surface layers of Be–Ca alloys formed. These metallized layers can be used as mother-alloys for fusion with noncoated Be. (France)

5638 PROCESSES OF PLASTIC DEFORMATION AND POLYGONIZATION DURING PRODUCTION OF MOLYBDENUM STRIPS WITH A SINGLE-CRYSTAL STRUCTURE. Savitskii, E. M.; Burkhanov, G. S.; Ottenberg, E. V. Fiz. Khim. Obrab. Mater.; No. 4, 57-60(1972). (In Russian).

Molybdenum ribbons with a single-crystal structure were obtained by alternately rolling and annealing Mo single crystals. Changes in the substructure of the crystalline Mo were analyzed at various stages of the rolling-annealing schedule. The polygonal single crystal structure assured a combination of high plasticity, low gas evolution, and good structure stability. (tr-auth)

5639 ULTRASOUND FLATTENING OF REFRACTORY METAL WIRES. Ignatsev, E. P.; Konovalov, E. G. Tsvetn. Metal.; No. 9, 73-4(Sep 1972). (In Russian).

Experimental data were obtained on the flattening of Mo alloy wires to micro-ribbons by means of ultrasound vibrations at 21 kHz and an amplitude of the movable plate of 0.015 mm. A considerable degree of reduction in thickness of refractory alloys could be obtained in this manner without the use of lubricants and heating. (tr-auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 5731, 6834, 6859, 6860, and 6862.

5640 (AD–741930) DEVELOPMENT OF PRECIPITATION STRENGTHENED NIOBIUM-BASE ALLOYS. Final Report, March 1969–September 1970. Cornie, J. A. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Dec 1971. Contract F33615-69-C-1464. 117p. (AFML-TR-71-51). NTIS.

A Nb-base alloy composition, Nb–22W–4Hf–0.05C–0.05N (designated C-6), which can be thermally treated to alter its strength properties was developed. In the as-solution annealed and aged condition, the 0.2% offset yield strength was 87,000 psi at 1400°F and 82,000 psi at 2200°F. Although developed primarily as a forging alloy, the composition can be processed to sheet with final rolling at 600°F. The C-6 composition evolved from studies of Nb–22W base alloys with zirconium and hafnium additions in combination with carbon and/or nitrogen. Zirconium additions were superior to hafnium at the 2 atom percent level in enhancing response to thermal treatment; however, hafnium bearing compositions were more fabricable than those containing zirconium. Partial substitution of tungsten with molybdenum showed that on an atom for atom basis, molybdenum was half as effective as tungsten with respect to improving creep resistance but was equally detrimental in raising the ductile to brittle transition temperature. (auth) (GRA)

5641 (AD–742143) RATE-DEPENDENT CONSTITUTIVE MODEL OF SHOCK-LOADED S-200 BERYLLIUM. Final Report, August 14, 1971–January 15, 1972. Read, H. E.; Cecil, R. A. (Systems, Science and Software, La Jolla, Calif.). Apr 1972. Contract DASA01-70-C-0055. 90p. NTIS.

A rate-dependent constitutive model is developed for the one-dimensional deformation of S-200 beryllium at room temperature. The current knowledge of dislocation dynamics is used in formulating the constitutive model from consideration of the basic physical mechanisms that are involved in plastic flow processes. The constants which arise in the model are evaluated from macroscopic data, including quasi-static strain hardening data, low-to-medium strain rate data, and stress wave profiles. A numerical scheme for incorporating this constitutive model into one-dimensional, finite-difference computer codes has been developed and implemented into the RIP code. Calculations of the attenuation of thin stress pulses show excellent agreement with experimental observations. (auth) (GRA)

5642 (AD–742522) DYNAMIC PROPERTIES OF S-200-E BERYLLIUM. Final Report, April 29, 1971–August 31, 1971. Christman, D. R.; Feistmann, F. J. (General Motors Corp., Warren, Mich. Materials and Structures Lab.). Feb 1972. Contract DASA01-68-C-0114. 63p. (MSL–71-23; DNA–2785-F). NTIS.

Results of an experimental study of the dynamic properties of S-200-E beryllium are presented. Areas studied included uniaxial stress behavior, elastic constants, equation of state, elastic precursor decay, and shock wave profiles. The material showed a yield "plateau" and then significant strain hardening, and exhibited strain rate sensitivity. Longitudinal and shear wave velocities at 20°C were 12.84 and 8.86 mm/μs. The shock wave equation of state up to 30 kb was determined to be linear: $\sigma_H = 0.7 + 152.7\ u_p$. Compressive wave tests showed a ramped, non-steady-state elastic precursor, and shock wave profiles showing both release behavior and attenuation were obtained. Scanning microfractographs were taken of spall fracture surfaces. (GRA)

5643 (AD–745123) REVIEW OF TEXTURES FOUND IN COMMERCIAL TITANIUM SHEET. Zarkades, Anthone; Larson, F. R. (Army Materials and Mechanics Research Center, Watertown, Mass.). Dec 1971. 79p. (AMMRC-TR–71-60). NTIS.

A compilation of data generated during studies concerning the development and characterization of titanium textures is presented. Results include pole figures, elastic and plastic properties in tension, and microstructures. Materials were examined in the as-received condition and in some cases after various heat treatments. A wide range of textures were found for nine titanium alloys including commercially pure Ti–6Al–4V, Ti–4Al–3Mo–1V, Ti–8Al–1Mo–1V, Ti–6Al–6V–2Sn, Ti–8Mn, Ti4Al–4Mn, Ti–16V–2.5Al, and Ti–7Al–3Mo. The textures found indicate that the technological barrier for application of texture strengthening is due to the lack of established mill procedures for developing the desired texture and not that the specific preferred orientations are unattainable in titanium alloys. (auth) (GRA)

5644 (CEA-R–4326) ISOTHERMAL PRECIPITATION IN U ALLOYS. PRECIPITATION KINETICS. Stelly, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sep 1972. 121p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Poitiers Univ., France.

The isothermal precipitation in four binary alloys of α phase uranium containing only small quantities of Al, Fe, Mo, and Ti was studied using various methods. An apparatus was developed to measure the electrical resistance of samples during aging. The results of these measurements demonstrated that these alloys do not obey the Matthiessen law. The precipitation kinetics were established between 450 and 650°C. The precipitation proceeded more rapidly with higher aging temperatures and more brutal quenching. The very rapid precipitation of U_6Fe is explained by the high diffusion coefficient of Fe: 3.10^{-10} cm^2/s at 645°C. Micrographic studies indicated that the precipitation is completely continuous in UAl and UFe alloys. In UMo and UTi, the continuous precipitation is preceeded below 600°C by a discontinuous precipitation restricted to old γ grain boundaries. The precipitates located within the α grains appeared as rods with axes parallel to the [100] direction of the α uranium. The kinetics were studied by electrical resistance and hardness measurements, and micrographic observations. The orientation relations between precipitate and matrix were compared. (France)

5645 (CNLM–2487) DISCUSSION OF COLUMBIUM–1.0 ZIRCONIUM ALLOY PROPERTIES RELATIVE TO THE PWAR-11C REACTOR STRUCTURAL DESIGN. Bigelow, C. C.; Gray, H. C.; Robison, D. E.; Rowe, G. H.; Shank, M. E.; Soderberg, C. R.; Triner, N. H. (Pratt and Whitney Aircraft, Middletown, Conn.). 31 Aug 1960. Contract AT(11-1)-229. 80p. Dep. NTIS.

Declassified 31 Oct 1972.

Properties of Nb–1 Zr alloy for use in components of aircraft nuclear power plants are examined. It is shown by data presented on mechanical properties, that the material is well understood and that it has no adverse properties. It is also shown that through the selection of criteria and the analysis of the structure, the niobium–1 zirconium alloy has adequate strength and ductility at the temperature levels in which it is required to perform. The main emphasis is on the reactor structural design; the results of the pressure vessel analysis are presented in detail as a typical example of the approach. (J.R.D.)

5646 (EUR–4893) ROLE OF CAESIUM IN CHEMICAL INTERACTION OF AUSTENITIC STAINLESS STEELS WITH URANIUM PLUTONIUM OXIDE FUELS. Ohse, R. W.; Schlechter, M. (European Inst. for Transuranium Elements, Karlsruhe (West Germany)). 22 Aug 1972. 27p. Dep. NTIS (U.S. Sales Only). EUR B.Fr.40.–.

The role of cesium in fuel-cladding interaction of austenitic stainless steels with mixed oxide fuels is discussed by considering the phase relationships, oxygen potentials, and defect structures of the oxide layers and the oxygen containing liquid multicomponent cesium phase. The possible reaction mechanisms of the various kinds of attack, the formation of a layered structure, the surface ablation of steel or matrix attack, and the intergranular attack are discussed. The initial alloy oxidation state of the stainless steels, obtained by the formation of a passivating oxide scale is considered on the basis of the chromium content, the constitution diagram and the oxygen partial pressure at the fuel surface. Dissolution of the oxide components at high burnup in the oxygen containing liquid cesium phase by oxygen exchange reactions gives a reasonable explanation for changes in oxidation rate caused by changes in defect concentration. The scale formation, stress development, breakdown of the oxide layers, and penetration of the oxygen containing cesium in between the oxide film and the alloy explain the strong increase of corrosion. (112 references). (auth)

5647 (LA–5002) EVALUATION OF URANIUM ALLOYS. Erickson, W. C.; Jaynes, G. E.; Sandstrom, D. J.; Seegmiller, R.; Taub, J. M. (Los Alamos Scientific Lab., N. Mex.). Sep 1972. Contract W-7405-eng-36. 19p. Dep. NTIS.

The oxidation resistance and mechanical properties of 23 uranium alloys have been evaluated. The U–Ti alloys had good mechanical properties, whereas U–Nb alloys had the best oxidation resistance. (auth)

5648 (N–72-23536) ALLOY HARDENING AND SOFTENING IN BINARY MOLYBDENUM ALLOYS AS RELATED TO ELECTRON CONCENTRATION. Stephens, J. R.; Witzke, W. R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1972. 29p. (NASA-TN-D–6810; E–6834). NTIS.

An investigation was conducted to determine the effects of alloy additions of hafnium, tantalum, tungsten, rhenium, osmium, iridium, and platinum on hardness of molybdenum. Special emphasis was placed on alloy softening in these binary molybdenum alloys. Results showed that alloy softening was produced by those elements having an excess of s + d electrons compared to molybdenum, while those elements having an equal number or fewer s + d electrons that molybdenum failed to produce alloy softening. Alloy softening and alloy hardening can be correlated with the difference in number of s + d electrons of the solute element and molybdenum (auth) (STAR)

5649 (ORNL–4820, pp 38–95) FAST REACTOR TECHNOLOGY. Sep 1972.

In Metals and Ceramics Division annual progress report for period ending June 30, 1972.

Research and development progress is reported on breeder reactor fuel development, compatibility of boiler materials, neutron absorbers, oxide fuels, cladding materials, joining of structural materials, mechanical properties of reactor alloys, and nondestructive testing. (J.R.D.)

5650 (ORNL-TM–3925) NOTCH SHARPENING IN A LARGE TENSILE SPECIMEN BY LOCAL FATIGUE. Abbatiello, A. A.; Derby, R. W. (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 21p. Dep. NTIS.

Fatigue cracks were grown from notches in large tensile specimens by cyclically applied high pressure. The notch was sealed with an O-ring which was held in place by a specially designed clamp. Approximately 25,000 cycles with a peak pressure of 18,000 psi were required to produce 0.4 in. of fatigue crack in the bottom of a 2-in.-deep notch. The growth of the crack was monitored with ultrasonics using both the pulse-echo and the sender-receiver method. (auth)

5651 (ORO–3612-9, pp 98–116) EFFECT OF OXYGEN ON THE DISLOCATION STRUCTURES IN VANADIUM. Huang, Y.; Arsenault, R. J. (Univ. of Maryland, College Park). 1972.

In Investigation of irradiation strengthening of b.c.c. metals and solid solutions.

A predominance of straight screw dislocations is observed in bcc metals deformed at large effective stresses, i.e., low temperatures. This observation has been used as evidence that the double kink mechanism is the rate controlling mechanism of dislocation motion. If interstitial atoms were the short range barriers to dislocation motion, then a significant density of edge dislocation should be observed in samples deformed at large effective stresses. An investigation of vanadium containing various levels of oxygen (15 to 1000 wt-ppM) was undertaken. The samples were deformed at small and large effective stresses in both tension and compression. One of the most significant observations was the predominance of screw dislocations in samples deformed at large effective stresses, independent of oxygen concentration. Therefore, the interstitial oxygen atoms can not act directly as short range barriers to dislocation motion. (auth)

5652 (RFP-Trans–117) STUDY OF PREFERRED ORIENTATION OF HEXAGONAL METALS WITH SUBCRITICAL VALVES C/A. Volf, F. Translation of a Czech report. 36p. Dep. NTIS.

Research directed to the development of x-ray crystallographic methods of qualitative and quantitative nature to determine the preferred orientation of hexagonal metals and their applicability in zirconium and magnesium rods acquired through mechanical formation by various degrees of deformation is reported. For zirconium, where changes in form are noted after irradiation and anisotropy, single crystal thermal expansion is accomplished by computation of variable characteristics of growth index and the coefficient of thermal expansion from measurements of preferred orientations. Results of investigations were basis for selection of the Harrison method, primarily developed for determining the texture of uranium, for adaptation to use with zirconium and magnesium. (J.R.D.)

5653 INFLUENCE OF EXTERNAL FACTORS ON MARTENSITE TRANSFORMATIONS WITH ATHERMAL OR ISOTHERMAL KINETICS. Georgieva, I. Ya.; Nikitina, I. I. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 33: No. 1, 144–50(Jan 1972). (In Russian).

The influence of various factors on the isothermal and athermal components of kinetics of the martensite $\gamma \rightarrow \alpha$ transformation in Fe–Ni–Mo alloys (23% Ni, 5.2% Mo) was investigated. Cooling rates from the temperature of austenization were examined, and within the interval of martensite transformation, the preliminary plastic deformation, phase cold-hardening, and grain size were observed. All the factors mentioned had a definite effect on the isothermal component of the kinetics of the $\gamma \rightarrow \alpha$ transformation, and practically no effect on the athermal component. (tr-auth)

5654 LAVES PHASES OF ACTINIDE ELEMENTS. Lam, D. J.; Mitchell, A. W. (Argonne National Lab., Ill.). J. Nucl. Mater.; 44: No. 3, 279–84(Sep 1972).

The crystal structure and lattice constants of eight new neptunium Laves phases and three new americium Laves phases are reported. The results, together with the previously published data, are discussed in terms of atomic size and electronic effects. The occurrence of lanthanide and actinide Laves phases is also summarized and compared. (auth)

5655 STUDIES OF STABILITY OF THE STRUCTURE AND MECHANICAL PROPERTIES OF MOLYBDENUM UNDER LONG-TERM TEMPERATURE AND STRESS. Drozd, N. P.; Ivashchenko, R. K.; Maksimovich, G. G.; (and others). Probl. Prochnosti; No. 4, 68–75(Apr 1972). (In Russian).

The influence of long-term application of temperature and stress on the structural stability and mechanical properties of molybdenum-based low alloys with preliminary formation of cellular structure was studied. It was found that changes in mechanical properties of deformed molybdenum alloy during annealing under load are determined basically by the annealing temperature, not by the load or holding time at the temperature, within the temperature range studied (800 to 1000°C). The action of the load during annealing of deformed molybdenum caused no significant increase in temperature of transition to the brittle state. The introduction of dispersed second phase particles allowed reliable stabilization of the cellular structure in molybdenum at 1000°C with significant loads over long periods of time. If annealing of deformed molybdenum was performed in the temperature interval in which primary recrystallization occurred, additional application of loads during annealing could slightly increase the re-

crystallization rate and decrease strength characteristics. (JPRS)

5656 REGULARITIES OF CREEP AND LONG-TERM RUPTURE OF MOLYBDENUM AND ITS ALLOYS. Zasimchuk, E. E.; Krivenyuk, V. V. Probl. Prochnosti; No. 6, 33-7(1972). (In Russian).

An experimental study was made on the regularities of creep and long-term rupture of slightly alloyed molybdenum-base alloys in comparison with molybdenum of technical purity. The composition of the materials studied was: technical molybdenum, 99.97% pure; TsM-2A, 0.075% Zr, 0.18% Ti, 0.003% C, 0.004% O_2, 0.004% N_2, 0.003% H_2; TsM, 0.14% Zr, remainder of TsM, and TsM-2A-molybdenum. The results of long term strength and deformation rate are presented, as well as descriptions of structural changes during creep of the specimens. The significance of diffusion softening processes (polygonization and grain growth) for deformation rate during creep was determined, and the mechanism of the influence of microalloying on creep characteristics and long-term rupture characteristics was studied. (JPRS)

5657 ANISOTROPY OF LATTICE PARAMETERS OF GAMMA-PHASE IN THE MARTENSITE INTERVAL OF TRANSFORMATION. Ershov, V. M.; Oslon, N. L. Fiz. Metal. Metalloved.; 33: No. 1, 215-17(Jan 1972). (In Russian).

The temperature dependence of lattice parameters of the γ-phases of two metallic samples was studied: a carbon-free iron alloy with 12% Ni, 15% Co, and 9% Mo; and a steel containing 0.4% C, 4.6% Mn, 0.1% Cr, and 0.25% Si. Thin samples were heated in a vacuum to the temperature of austenitization, and the two interference lines (111) and (200) were observed during subsequent cooling. The data showed that from the beginning of the martensite transformation, processes occurred which lead to anisotropic changes in the interplanar distances. (K.S.W.)

5658 STUDY OF CARBIDE TRANSFORMATION ON THE TEMPERING OF THE SOLID SOLUTION OF TUNGSTEN AND TUNGSTEN–MOLYBDENUM HIGH-SPEED STEELS. Kupalova, I. K.; Baikov, A. M.; Kabaev, M. M. (All-Union Scientific-Research Instrument Inst., Moscow). Fiz. Metal. Metalloved.; 33: No. 1, 188-92(Jan 1972). (In Russian).

The consequences of carbide phase separation during tempering of the solid solution of W and W–Mo high speed steels were investigated. The steels selected for testing contained from 3.4 to 7.1% W, 2.4% Mo, and about 1% V. Separation of the carbide phase onto the V_2C lattice was indirectly confirmed by dilatometric investigations. The dilatometric curve was interpreted as the result of two completing processes: the carbide phase possessed a greater specific volume than martensite, and the decomposition of martensite with a reduction of specific volume. (K.S.W.)

5659 INTERDENDRITIC STRUCTURES OF A DIRECTIONALLY SOLIDIFIED COBALT-BASE ALLOY. Arora, O. P.; Dapkunas, S. J. (Annapolis Lab., Md.). Met. Trans.; 3: No. 11, 3033-5(Nov 1972).

The microstructures produced in directional solidification of a chromium–cobalt-base-nickel-tantalum alloy at various speeds and the variation of its microhardness with respect to the speed of growth is described. (T.F.D.)

5660 RATE OF VAPORIZATION OF TUNGSTEN IN ARGON. Harvey, F. J. (Westinghouse Research Labs., Pittsburgh). Met. Trans.; 3: No. 11, 2973-8(Nov 1972).

The vaporization kinetics of thin tungsten wires has been measured under natural convection conditions in high-purity argon. The rate was determined as a function of argon pressure and filament temperature in the range between 80 and 300 mm and 2850 and 3150 K. The vaporization rate is exponentially related to temperature with an activation energy of approximately 190 kcal/mole and inversely proportional to total pressure to the 0.87 power. The activation energy predicted by stagnant-film mass transfer theory is 202.5 kcal/mole, while the theoretically predicted inverse pressure dependence is 0.90. The rate was also sensitive to reactive impurities in the argon; thus, in situ, purification of the atmosphere was required. (auth)

5661 DISTRIBUTION OF BORON IN AUSTENITE. Jandeska, W. F. Jr.; Morral, J. E. (Univ. of Illinois, Urbana). Met. Trans.; 3: No. 11, 2933-7(Nov 1972).

The partitioning of boron between grain boundary and austenite matrix sites in steel has been examined by the use of boron autoradiography. Results show that in alloys containing 0.0037 at. % B and 0.68 at. % C, boron segregates to the austenite grain boundary with a binding energy of 9.6 ± 1.0 kcal/mole. In addition to this experimental observation, the effect of carbon concentration on the boron distribution is considered theoretically. (auth)

5662 TEMPERING OF LOW CARBON STEELS CONTAINING TUNGSTEN. Lupton, J. B.; Murphy, S.; Woodhead, J. H. (Univ. of Sheffield, Eng.). Met. Trans.; 3: No. 11, 2923-31(Nov 1972).

The tempering behavior of three steels each containing 0.20 pct C and having tungsten contents of 2.1, 3.9, and 5.9 pct has been followed by thermomagnetic analysis and electron microscopy. Using a Sucksmith Balance, the proportions of autotempered carbide and retained austenite in as-quenched specimens were estimated, and the amount of cementite precipitated upon subsequent tempering measured accurately. Solution of tungsten in cementite during tempering was monitored by observing changes in Curie temperature. The magnetic nature of alloy carbides precipitating at high temperatures allowed tentative identification and this directed and assisted the electron microscopy study which provided new information on the morphology of tungsten carbides. (auth)

5663 DENSITY AND SURFACE TENSION OF DILUTE LIQUID Na–In ALLOYS AND COMPARISON WITH LIQUID NA–Cd ALLOYS. Davies, H. A. (Univ. of Sheffield, Eng.). Met. Trans.; 3: No. 11, 2917-21(Nov 1972).

The density and surface tension of five liquid Na–In alloys, containing between 0.5 and 7 at. % In, have been measured in the temperature range 170 to 400°C using a maximum bubble pressure technique which incorporates an automatic pressure measuring and recording device. The results are compared with corresponding data reported previously for Na–Cd alloys. The gram-atomic volumes of the Na–In alloys, calculated from the densities, indicate a substantial contraction on alloying which is, on average, about double that for the Na–Cd alloys and qualitatively consistent with thermodynamic data for the two systems. The surface tension of liquid sodium is increased slightly on adding indium, indicating a lower indium concentration in the surface than in the bulk, in contrast to the marked surface active behavior of cadmium. The surface excess concentrations of indium and cadmium are calculated using Gibbs' adsorption equation. The surface excess entropy, estimated from the temperature dependence of the surface tension, is compared and briefly discussed for the two systems. (auth)

5664 NEW INTEGRATION OF THE GIBBS–DUHEM EQUATION AND THERMODYNAMICS OF Pr–Zn ALLOYS. Chiotti, P. (Ames Lab., Iowa). Met. Trans.; 3: No. 11, 2911-16(Nov 1972).

A new method for integrating the Gibbs–Duhem equation has been developed which lends considerable versatility to the types of curves or functions which can be integrated to yield data for a second component in a binary alloy solution. The area under curves of X_iY_i vs X_i, where Y_i is any excess partial molar quantity and X_i is the mole fraction of component i, can be employed to evaluate the excess partial molar quantities of the second component. These curves must go to zero at $X_i = 1$ and $X_i = 0$, with a slope of zero at $X_i = 1$ and a slope equal to Y_i at $X_i = 0$. This procedure was applied to an analysis of the thermodynamic properties of liquid Pr–Zn alloys. The results obtained indicate that for this system the α function or $\Delta\bar{G}^{xs}_{Zn}/(1 - X_{Zn})^2$ goes to zero at $X_i = 1$ and that previous extrapolations of the α function in the composition range of $X_{Zn} = 0.9$ to 1.0 were erroneous. (auth)

5665 HYDROGEN IN β TRANSFORMED Ti–6Al–4V. Pittinato, G. F.; Hanna, W. D. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). Met. Trans.; 3: No. 11, 2905-9 (Nov 1972).

The internal reactions associated with hydrogen absorbed at ambient temperature by Ti–6Al–4V having a transformed β microstructure were determined by using x-ray diffraction analysis. Below 650 ppM, the absorbed hydrogen was concentrated primarily in the β phase causing an increase in the $d_{(200)}$ spacing and considerable x-ray line broadening. The α phase, however, was not significantly affected by the absorbed hydrogen showing no change in the $d_{(11\bar{2}0)}$ and $d_{(10\bar{1}2)}$ spacings and only a finite amount of line broadening. At approximately 650 ppM H, hydride precipitation began at the α–β interface. With increasing hydrogen content, the β phase $d_{(200)}$ spacing continued to increase, the (200) x-ray line broadening reached a limiting value, and massive hydrides were formed. The data indicates that low concentrations of hydrogen absorbed by α–β titanium alloys can be detected by examining the x-ray line profile of the β phase. (auth)

5666 ACTIVITY OF CARBON AND SOLUBILITY OF CARBIDES IN THE FCC Fe–Mo–C, Fe–Cr–C, AND Fe–V–C ALLOYS. Wada, T.; Wada, H.; Elliott, J. F.; Chipman, J. (Massachusetts Inst. of Tech., Cambridge). Met. Trans.; 3: No. 11, 2865-72 (Nov 1972).

The activity of carbon in austenitic Fe–Mo–C, Fe–Cr–C, and Fe–V–C alloys has been studied by equilibration with con-

trolled CH_4-H_2 atmospheres at temperatures in the range 850 to 1200°C. The observations included a number of compositions in the two-phase fields, γ + carbide. Equations are given for the activity coefficient of carbon as a function of temperature and composition in the austenite field and from these the other thermodynamic properties of the solution may be computed as desired. The phase boundaries γ/γ + carbide were determined by breaks in the isoactivity lines. This was supplemented in the case of Fe–Mo–C alloys by metallographic linear analysis of equilibrated samples. The results confirm certain published phase diagrams and discredit others. (auth)

5667 ENERGY, STABILITY, AND PEIERLS STRESS OF GLIDE DISLOCATIONS IN ANISOTROPIC BCC CRYSTALS. Chou, Y. T.; Sha, G. T. (Lehigh Univ., Bethlehem, Pa.). Met. Trans.; 3: No. 11, 2857-63(Nov 1972).

The elastic energy E of a straight glide dislocation in bcc crystals is analyzed as a function of crystal orientation. Approximate energy functions are obtained for dislocations on the {110}, {112}, and {123} slip planes. Regions of instability for glide dislocations are found to exist only in highly anisotropic crystals, Li, Na, K, and β-brass. The Peierls stresses σ_p and the widths of edge and screw dislocations are also analyzed. For most common bcc crystals, the following inequalities hold: $E^{\{110\}} < E^{\{123\}} < E^{\{112\}}$ for edge dislocations, $\sigma_p^{\{110\}} < \sigma_p^{\{112\}} < \sigma_p^{\{123\}}$ for both edge and screw, and $(\sigma_p)_e < (\sigma_p)_s$ between the edge and screw on the same slip plane, where the subscript p stands for Peierls, e for edge, s for screw, and the superscripts refer to the slip planes. (auth)

5668 LAVES PHASE PRECIPITATION IN Fe–Ta ALLOYS. Jones, R. H.; Zackay, V. F.; Parker, E. R. (Univ. of California, Berkeley). Met. Trans.; 3: No. 11, 2835-42(Nov 1972).

Development of an iron-base alloy hardened by particles of an intermetallic compound rather than a carbide is a desirable goal because of the greater thermal stability of such a dispersion. As a first step in the development of iron-base alloys hardened with the Laves phase, structural studies of binary Fe–Ta alloys have been undertaken. The structures of two phase Fe–Ta alloys have been studied by means of optical and transmission electron microscopy, X-ray diffraction, electron beam microprobe analysis, and scanning electron microscopy. The hardness change as a function of time at 600, 700, and 800°C has been determined for binary alloys with 1 at. % Ta and 2 at. % Ta in iron. Also, the uniaxial tensile strengths of solution treated, quenched, and aged samples have been determined. These studies suggest that the compound, Fe_2Ta, is isomorphous with the structure type, $MgZn_2$, (C14) and has a range of compositional homogeneity. The latter results correspond with the predictions of the Engel–Brewer correlation. Also, it has been found that precipitation occurs at grain boundaries, dislocations, and randomly throughout the matrix. Particles which form at dislocations have a $(100)_\alpha$ habit plane; whereas a $(110)_\alpha$ habit plane has been reported by others for the hexagonal Laves phase in α iron. Hypereutectoid composition alloys quenched from the δ phase field have a completely retained δ structure. Isothermal decomposition at 600, 700, and 800°C of alloys with the retained δ structure results in a sizable hardness increase in 2 at. % Ta alloys but only a modest increase in 1 at. % Ta alloys. Brittle fracture of aged tensile specimens tested at room temperature reveals that the ductile-brittle transition temperature in tension is above room temperature. (auth)

5669 MICROSTRUCTURE AND PHASE RELATIONS FOR Ti–Mo–ALLOYS. Hamajima, T. (Rutgers–The State Univ., New Brunswick, N. J.); Luetjering, G.; Weissmann, S. Met. Trans.; 3: No. 11, 2805-10(Nov 1972).

The influence of aluminum additions to a Ti-7 at. % Mo alloy on the phase equilibria was investigated. The microstructures of the alloys, Ti-7% Mo-7% Al and Ti-7% Mo-16% Al, were determined by light and electron microscopy. It was found that with increasing aluminum concentration the formation of the metastable ω phase was suppressed. In the Ti-7% Mo-16% Al alloy the β phase decomposed upon quenching by precipitating coherent, ordered particles having a B2 type of crystal structure (β_2). At low temperatures the equilibrium phases for this alloy were $\beta + \alpha + \beta_2$, whereas at high temperature (850° to 950°C) the Ti_3Al phase was in two-phase equilibrium with the β phase. The four-phase equilibrium which exists at a temperature of about 550°C involves the reaction $\beta + Ti_3Al \rightleftharpoons \alpha + \beta_2$. (auth)

5670 PEARLITE REACTION. Puls, M. P.; Kirkaldy, J. S. (McMaster Univ., Hamilton, Ont.). Met. Trans.; 3: No. 11, 2777-96(Nov 1972).

A critical appraisal of theory and experiments for both isothermal and forced velocity pearlite is presented. It is concluded for binary systems that both the theoretical models for volume diffusion and boundary diffusion control are well-advanced and adequate for the purposes of experimental test. However, some ambiguity remains in the boundary diffusion model with respect to the thermodynamics of the boundary "phase" region, so it is still not possible to predict absolute rates of transformation. The theoretical problem for ternary pearlites is also well understood, although rigorous theory seems intractable. A new perturbation procedure for definition of the optimal steady-state spacing is presented and amplified for both isothermal and forced velocity pearlite, and for both volume and boundary diffusion models. In terms of the critical spacing S_c for isothermal pearlite and the spacing at minimum undercooling S_m for forced velocity pearlite the predicted stability points are as follows:

	Volume	Boundary
Isothermal	$3S_c$	$2S_c$
Forced	$\sqrt{2}S_m$	$^2/_3^{\frac{1}{2}} S_m$

For isothermal pearlite these perturbation results correspond closely to the state of maximum entropy production rate while for forced velocity pearlite the correspondence is also satisfactory. A detailed analysis of the data leads to the conclusion that the eutectoid reactions in Cu-12 pct Al and some related ternary alloys reported by Asundi and West are controlled by volume diffusion and that the eutectoid reaction in Al-78 Zn reported by Cheetham and Ridley is controlled by boundary diffusion. The pearlite reaction in Fe-0.8 C is controlled for the higher temperatures by volume diffusion of carbon in austenite. The pearlite transformations in Fe–C–Mn and Fe–C–Ni occur for the most part in a nopartition regime and are therefore controlled by volume diffusion of carbon in austenite, while the transformations in Fe–C–Cr and Fe–C–Mo, being forced by thermodynamics to sustain partition of chromium and molybdenum, are controlled by phase boundary diffusion of the latter elements. (auth)

5671 GENESIS OF THE CELLULAR PRECIPITATION REACTION. Fournelle, R. A.; Clark, J. B. (Univ. of Missouri, Rolla). Met. Trans.; 3: No. 11, 2757-67(Nov 1972).

The morphology of cellular precipitation in a Cu-9.5 at. % In alloy has been investigated by light and electron microscopy. Both cellular and general precipitation were observed to occur simultaneously in quenched and aged alloys while only cellular precipitation was observed to occur in isothermally aged alloys. Because of the presence of wide, solute rich, precipitate free zones in the vicinity of grain boundaries in the quenched and aged alloys, the early development of cellular precipitation was found to be identical for both types of heat treatment. From light and electron microscopy observations of the early stages of cellular precipitation a mechanism for the formation of cells was developed. At the start of aging, the unoccupied grain boundary begins to migrate under the influence of grain boundary migration forces as if it were in a single phase alloy. As the boundary migrates, solute segregates along it form allotriomorphs which pin the boundary. The boundary continues to migrate and bows between the simultaneously forming allotriomorphs. With further aging, the allotriomorphs lengthen following the bowing boundary and the allotriomorphs become the initial precipitate lamellae of the developing cell as a steady-state lamellar structure develops. Assuming that the critical step in the development of a cell is the ability of the boundary to bow between the initial allotriomorphs, a criterion for the occurrence of cellular precipitation was developed. (auth)

5672 EFFECTS OF HYDROSTATIC PRESSURE ON THE DIFFUSION OF Cd IN MONOCRYSTALLINE Mg. Combronde, J. (CEN, Saclay, France). Scr. Met.; 6: No. 9, 801-6(Sep 1972). (In French).

The diffusion of Cd into monocrystalline Mg was studied at 498°C in a pressure range from 0 to 8 kb, using the electron microprobe technique. The activation volume of the heterodiffusion in the base plane ($\Delta V_{\perp 0}$) and parallel to the z axis ($\Delta V_{\parallel 0}$) were evaluated from the slope of the lines Log ($D_{\perp 0} - D_{\parallel 0}$) and Log $D_{\parallel 0}$ as 15.3 ± 1.2 cm^3/mole or 1.10 Ω and 14.4 ± 1.4 cm^3/mole or 1.04 Ω respectively. The differences are not significant as they are within the limits of experimental error. A lacumar mechanism of diffusion was assumed and the experimental results were evaluated to see if they were compatible with existing models. The Keyes model was satisfactory for the compact metals, but unsatisfactory for Na and Li and the transition metals. (J.S.R.)

5673 INFLUENCE OF MOLYBDENUM ON THE THERMODYNAMIC ACTIVITY OF CARBON IN SOLID IRON. Petrova, E. F.; Shvartsman, L. A. (Inst. of Metal Science and Physics of Metals, Moscow). Dokl. Akad. Nauk SSSR; 205: No. 6, 1404-6(21 Aug 1972). (In Russian).

The interaction between C and other elements dissolved in iron

leads to a change in the thermodynamic activity of C. In connection with finding the change in the partial enthalpy of C caused by the presence of Mo in the solid iron, measurements were made of the temperature dependence of the activity coefficient of C in the temperature range 800 to 1050°C, and for alloys containing from 0.42 to 1.23% Mo. The data indicated that the decrease in the activity coefficient of C and its partial free energy in ferrite in the presence of Mo was not caused by an increase in the bond energy with the solid solution, but by an increase in its partial entropy. (K.S.W.)

5674 PHYSICOMECHANICAL PROPERTIES OF TECHNETIUM. Spitsyn, V. I.; Golovanov, Yu. N.; Balakhovskii, O. A.; Tsvetaev, A. A. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 205: No. 6, 1421-4(21 Aug 1972). (In Russian).

The following behavior and characteristics of metallic Tc were investigated: melting of pressed (100 kg/mm^2) powdered Tc, the extrusion of Tc ingots at a speed of 8 to 10 mm/min and a reduction factor of 15 to 20%, cold hardening and cold workability, cold rolling and wire drawing, the anisotropy of thermal expansion, and the mechanical properties of uniaxial stretched metallic Tc before and after annealing. (K.S.W.)

5675 EFFECT OF BORON ON THE PRECIPITATED PHASES IN AGED TYPE 316 AUSTENITIC STAINLESS STEEL. Williams, T. M.; Talks, M. G. (Atomic Energy Research Establishment, Harwell, Eng.). J. Iron Steel Inst. (London); 210: No. 11, 870-1(Nov 1972).

It has been shown previously (Williams et al., 1970; 1972) that boron additions improve the 700°C creep–rupture properties of type 316 austenitic stainless steel. Casts of type 316 steel with controlled boron and carbon levels have now been obtained: the structures were examined by optical microscopy and the borocarbide precipitates extracted for x-ray diffraction lattice-parameter determinations. The following conclusions are presented: (1) boron additions (60 ppm) to type 316 austenitic steel produce small increases in the lattice parameter of the $M_{23}(C,B)_6$ precipitates which form on aging at 750°C and effectively suppress σ-phase formation for aging times up to 1000 h when the carbon content is relatively low (0.05 to 0.06%); (2) in high-carbon (0.12%) type 316 steel, the boron is less effective in preventing σ-phase formation at 750°C and has no measurable effect on the lattice parameter of the $M_{23}C_6$ or $M_{23}(C,B)_6$ precipitates; and (3) increasing the boron/carbon ratio in the steel probably results in a higher boron/carbon ratio in the precipitated borocarbide, such that its stability with respect to σ-phase formation and its lattice parameter are increased. (UK)

5676 STEAM GENERATOR SHELL BEHAVIOR UNDER PLASTIC DEFORMATION. Pop, M. G. M. (Georgia Inst. of Tech., Atlanta); Rust, H. R.; Tardos, G. Trans. Amer. Nucl. Soc.; 15: No. 2, 731(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5677 HOLD-TIME EFFECT IN HIGH-TEMPERATURE FATIGUE FRACTURE OF TYPE 304 STAINLESS STEEL. Kitagawa, M. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 736-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5678 SENSITIVITY OF ELEVATED-TEMPERATURE MECHANICAL PROPERTIES OF TYPE 304 STAINLESS STEEL TO HEAT-TO-HEAT VARIATIONS. Waddell, R. D. Jr.; Martin, W. R. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 737-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5679 TESTING OF URANIUM ALLOYS UNDER CONDITIONS OF RAPID FISSION HEATING. Reuscher, J. A. (Sandia Labs., Albuquerque, N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 763-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5680 HIGH-TEMPERATURE MEASUREMENTS OF ZIRCALOY CLADDING. Tkach, J. D. (Aerojet Nuclear Corp., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 2, 764-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5681 EFFECT OF CARBON ON THE MECHANICAL PROPERTIES OF 2$^1/_2$ PERCENT Cr–1 PERCENT Mo STEEL. Klueh, R. L. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 769(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5682 X-RAY TECHNIQUE FOR PHASE ANALYSIS IN AUSTENITIC STAINLESS STEEL. Spruiell, J. E. (Univ. of Tennessee, Knoxville); Gehlbach, R. E. Trans. Amer. Nucl. Soc.; 15: No. 2, 769-70(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5683 MICROSTRUCTURAL STABILITY OF THERMAL-MECHANICALLY PRETREATED TYPE 316 AUSTENITIC STAINLESS STEEL. Spruiell, J. E.; Scott, J. A.; Ary, C. S.; Hardin, R. L. (Univ. of Tennessee, Knoxville). Trans. Amer. Nucl. Soc.; 15: No. 2, 770-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5684 MICROSTRUCTURAL CHARACTERIZATION OF DEFORMED TYPE 316 AUSTENITIC STAINLESS STEEL. Brooks, C. R. (Oak Ridge National Lab., Tenn.); Spruiell, J. E. Trans. Amer. Nucl. Soc.; 15: No. 2, 771(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5685 MECHANICAL AND STRUCTURAL PROPERTIES OF TYPE 316 STAINLESS-STEEL LMFBR CLADDING. Padden, T. R.; Thomas, K. C.; Tarby, E. J. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 15: No. 2, 771-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5686 STRUCTURE AND PROPERTIES OF TYPE 316 WELD METAL. Ward, A. L. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 774-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5687 PROPERTIES OF THICK STAINLESS-STEEL-SHIELDED METAL-ARC WELDMENTS. King, R. T.; Goodwin, G. M.; Stiegler, J. O. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 775-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5688 IMPLICIT METHOD FOR THE TREATMENT OF INTERSTITIAL DIFFUSION IN A THERMAL GRADIENT. Gelbard, E. M.; Marino, G. P.; Schmidt, E. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 2, 781-2 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5689 CONCENTRATION DEPENDENCE OF THE LATTICE CONSTANT IN COPPER, SILVER, AND GOLD BASE ALLOYS WITH B METALS AND ITS RELATION TO THE ELASTIC MODULUS. Koester, Werner (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 63: No. 10, 633-8(Oct 1972). (In German).

The lattice constants of copper, silver and gold are increased or decreased linearly with concentration by the addition of B metals. The concentration dependence is represented by $\Delta a = \pm C\,p + \alpha\,p\,\Delta Z$. The concentration coefficient $d\Delta a/dp$ varies linearly with the valency of the B metal addition beginning from the positive or negative constant C. The relations between the lattice constant and Young's modulus are discussed. (auth)

5690 INTERACTION OF RARE EARTH METALS WITH THE GRAIN BOUNDARIES OF NICKEL AND ITS ALLOYS. Koval, A. D.; Natapov, B. S.; Ol'shanetskii, V. E. Fiz. Khim. Obrab. Mater.; No. 4, 102-7(1972). (In Russian).

The authors studied the effect of the rare earth elements Nd, Pr, Ce, and La on the energy-structure state of grain boundaries of refined nickel, nichrome (11% Cr), and twelve type ZhS6K alloys, all of which contained about 15% Cr, and individually contained either 0.02, 0.06, or 0.12 weight % of one of the following rare earths: Nd, Pr, Ce, or La. Protracted strength and impact strength deteriorated with excessive (up to 0.12%) micro-alloying. The grain boundary energy of 99.9999% Ni was studied as a function of the concentration of Ce and La. (K.S.W.)

5691 EXPERIMENTAL EVIDENCE OF CAVITY FORMATION DURING CREEP TESTING. Wirth, A.; Harris, K. W. (Sheffield Polytechnic, Eng.). pp 304-5 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From 5th European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

The formation of intergranular cavities in materials used at elevated temperatures has received much study, but little direct

evidence has been obtained that would confirm any of the several controversial cavity nucleation and growth theories; a possible technique for studying cavitation phenomena in thin sections suitable for electron transmission microscopy is, however, discussed here. The material studied was an 18/10/Nb stabilized stainless steel, solution-treated at 1300°C for 7 h and water-quenched prior to creep testing at 800°C under a load of 4.4 kg/mm^2. Several thin foils were prepared, the final thinning being carried out by the technique of ion bombardment. This process has the advantage of thinning materials at a comparatively uniform rate and hence any cavities present within a section tend to retain, to a substantial degree, their original shape and size. It was possible to see the structure across a cavity surface by conventional electron microscopy, but owing to the thickness of the adjacent regions neither the precise situation of the cavity nor the presence of other cavities could be determined. The foils were re-examined in a transmission electron microscope fitted with a transmission scanning attachment; this could be utilized in the examination of thicker foil sections, and cavities were observed at grain-boundary serration peaks. More work is to be carried out to investigate the detailed structure of the cavities. It is thought that the combination of the foregoing newer techniques of electron metallography holds considerable promise where information on the formation of creep cavities or similar defects is required. (UK)

5692 IMAGING OF URANIUM ATOMS WITH THE ELECTRON MICROSCOPE BY PHASE CONTRAST. A. SPECIMEN PREPARATION. Johnson, H. M.; Parsons, J. R.; Hoelke, C. W. (Chalk River Nuclear Labs., Ont.). pp 644-5 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From 5th European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

Specimens employed for single-atom imaging in the transmission electron microscope must satisfy rigid requirements both for imaging conditions and image interpretation. In the studies reported the requirements for U in the form of a complex with mellitic acid are described. (UK)

5693 IMAGING OF URANIUM ATOMS WITH THE ELECTRON MICROSCOPY BY PHASE CONTRAST. B. MICROSCOPY. Parsons, J. R.; Johnson, H. M.; Hoelke, C. W.; Hobsons, R. R. (Chalk River Nuclear Labs., Ont.). pp 646-7 of Electron Microscopy 1972. London; Inst. of Physics (1972).

The possibility of using phase contrast to image known groupings of heavy atoms in complex molecules and developing imaging techniques that do not rely on an a-priori knowledge of heavy atom positions in the molecule for proof that they have been imaged is discussed. Some studies with U in the form of a complex with mellitic acid are described. (UK)

Radiation Effects

Refer also to abstracts 5596, 5649, 6811, 6815, and 7161.

5694 (CEA-CONF-2030) PRODUCTION OF HELIUM AND HYDROGEN IN PILE IRRADIATED STEEL. Cance, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec 1970. 41p. (In French). (DPE/SPE-70-785; CONF-710353-1). Dep. NTIS (U. S. Sales Only).

From 29th conference of the Dosimetry Group of EURATOM; Petten, Netherlands (9 Mar 1971).

The quantities of He and H produced by nuclear reactions in steel are calculated for different placements of fast and thermal reactors. A method is described which makes it possible to take better account of the neutron spectrum effects even in cases in which only the averaged value on the fission spectrum is available for the cross section of a reaction. A systematic search of the available cross section values was made. The method described was applied to the case of type 316 stainless steel. A calculation code GAZ makes it possible to study different alloys of given composition in every reactor placement where the neutron spectrum is known and for different irradiation times. (tr-auth)

5695 (HEDL-SA-478) CONVERSION OF DISPLACEMENT PRODUCTION TO DEFECT PRODUCTION IN STAINLESS STEEL THROUGH COMPUTER EXPERIMENTS. Doran, D. G. (Hanford Engineering Development Lab., Richland, Wash.). Aug 1972. Contract AT(45-1)-2170. 16p. (CONF-721037-3). Dep. NTIS.

From Specialists' meeting on radiation damage units for ferritic and austenitic stainless steels; Seattle, WA. (31 Oct 1972).

Computer methods for estimating stainless steel defect production under neutron and ion bombardment are discussed. It is suggested that the correlation of swelling data is more firmly based on free production cross sections than on displacement cross sections. It is premature to recommend that defect cross sections be used routinely in reporting radiation exposures because the necessary calculations have not yet been carried out. When they have been, defect production rates could be an important supplement to, not replacement for, displacement rates as a unit in terms of which to report exposures and design irradiation experiments. (J.R.D.)

5696 (HEDL-SA-479) DEFINITION OF DAMAGE FUNCTIONS FROM IRRADIATION TEST DATA. Yoshikawa, H. H.; McElroy, W. N.; Simons, R. L. (Hanford Engineering Development Lab., Richland, Wash.). Aug 1972. Contract AT(45-1)-2170. 20p. (CONF-721037-4). Dep. NTIS.

From Specialists' meeting on radiation damage units for ferritic and austenitic stainless steels; Seattle, WA. (31 Oct 1972).

A method is described of determining irradiation effectiveness of different neutron spectra in causing radiation effects to fuel cladding and reactor structural materials. It involves the definition of a semi-empirical damage function or cross section using measured data from specimens irradiated in thermal and fast test reactor spectra. The damage function is applied to design problems involving irradiation effects to reactor structural and fuel cladding materials to predict the fluence which would produce a specific change in material properties. (auth)

5697 (ORNL-4820, pp 96-105) SPACE POWER TECHNOLOGY. Sep 1972.

In Metals and Ceramics Division annual progress report for period ending June 30, 1972.

Research and development progress is summarized on cladding materials for isotope heat sources, UN fuels, metallurgy of refractory metals, and W metallurgy. (J.R.D.)

5698 (ORNL-4820, pp 140-5) THERMONUCLEAR AND TRANSURANIUM RESEARCH. Sep 1972.

In Metals and Ceramics Division annual progress report for period ending June 30, 1972.

Research and development progress is reported on transuranium elements and support of thermonuclear reactor programs. (J.R.D.)

5699 (ORNL-4820, pp 146-77) OTHER PROGRAM ACTIVITIES. Sep 1972.

In Metals and Ceramics Division annual progress report for period ending June 30, 1972.

Research and development progress is reported on Al–U fuel elements, weld flow inspection by autoradiography, fabrication of Pu test elements, fuels for light water breeder reactors, metallography, properties of T-111 alloy, and NERVA support. (J.R.D.)

5700 (ORO-3612-9) INVESTIGATION OF IRRADIATION STRENGTHENING OF B.C.C. METALS AND SOLID SOLUTIONS. Progress Report for the Period January 1972–October 1972. Arsenault, R. J. (Maryland Univ., College Park). [nd]. Contract AT(40-1)-3612. 236p. Dep. NTIS.

Research and development progress is reported in appendixes on radiation effects on Mo single crystals, dislocation channeling in irradiated V, annealing effects on irradiated interstitial V alloys, anneal hardening of reactor materials, dislocation motion in metals and alloys, thermally-activated deformation, and yield behavior of V. A separate abstract was prepared for each of two appendixes. (J.R.D.)

For abstracts of individual sections see: 5651 and 5701.

5701 (ORO-3612-9, pp 138-53) POST-IRRADIATION ANNEAL HARDENING IN PROPOSED REACTOR MATERIALS. Hasson, D. F.; Arsenault, R. J. (Univ. of Maryland, College Park). 1972.

In Investigation of irradiation strengthening of b.c.c. metals and solid solutions.

Results of investigations are presented on radioinduced atom displacement damage in reactor materials. Results and discussion are included on Nb, V, Mo, and W. (J.R.D.)

5702 RADIATION RELAXATION OF STRAINS IN ZINC SINGLE CRYSTALS. Troitskii, O. A. (Inst. of Physical Chemistry, Moscow). Fiz. Metal. Metalloved.; 33: No. 1, 59-63(Jan 1972). (In Russian).

Irradiation by 0.4 to 3.5 MeV electrons of Zn single crystals under stress leads to a lowering of the yield limit and to an increase of the relaxed portion of the applied stress at the time the stress ceased. The relaxation of the stress is greatest in the region of yield limits of the samples. For a given flux intensity, a decrease in yield limits of the samples occurs with an increase in energy of the bombarding particles; simultaneously, the fraction of relaxed strain (radiation-mechanical effect) increases. Radiation alleviation of deformed metal was observed for electron energies which were sufficient for effect-

ing a displacement of atoms in the Zn lattice (E = 0.86 to 3.50 MeV). (tr-auth)

5703 VOIDS PRODUCED IN MILD STEEL BY 1 MeV ELECTRON IRRADIATION. Little, E. A. (Atomic Energy Research Establishment, Harwell, Eng.). Radiat. Eff.; 16: No. 1-2, 135-7(Sep 1972).

Mild steel was injected with helium by α-particle bombardment. Thin foils were irradiated at 550°C in a high voltage electron microscope operating at 1 MV. The development of the damage structure was observed continuously as the irradiation progressed. At low damage concentrations rectilinear dislocation loops formed and grew rapidly. The build up of a dislocation network observed at doses approaching ~5 d/a is believed to occur by both glide and climb following interaction between slip dislocations and loops. Voids 50 to 100 Å in diameter first became visible at this damage level. At the highest damage concentration of 30 d/a they were octahedral in shape. Their average diameter was ~190 Å and the total void concentration was $1.6 \times 10^{15}/cm^3$. The calculated volume change was in the range 0.9 to 1.3%. Comparison with other published results suggests that mild steel swells significantly less than 316 austenitic steel under similar conditions, but it is pointed out that void swelling is markedly temperature dependent in the narrow temperature range in which voids are produced. (UK)

5704 ROLE OF RADIOACTIVE DECAY IN IRRADIATION DAMAGE IN METALS. Coltman, R. R.; Klabunde, C. E.; Redman, J. K.; Southern, A. L. (Oak Ridge National Lab., TN). Radiat. Eff.; 16: No. 1-2, 25-32(Sep 1972).

The effects which may accompany radioactive decay in irradiated metals can be described in terms of five mechanisms. Two are responsible for the production of defects, and two can annihilate existing defects. The fifth mechanism is the formation of transmutations. The relative importance of each mechanism is dependent upon the nuclear properties and damage state of the metal. The experimental observation of the effects of some of these mechanisms is made by means of resistivity change measurements in thermal neutron-irradiated Cu, W, Re, and Au. The observation of those effects which produce compensating changes is accomplished through the use of post-irradiation annealing procedures and control of defect concentration. (auth)

5705 ELECTRON STEREOMICROSCOPY ANALYSIS OF VOIDS PRODUCED IN NICKEL DURING ION IRRADIATION. Chen, C. W. (Ames Lab., IA); Mastenbroek, A.; Elen, J. D. Radiat. Eff.; 16: No. 1-2, 127-32(Sep 1972).

The spatial distribution of voids produced in nickel during ion irradiation has been investigated by means of transmission electron stereomicroscopy. For 100 keV Ni^{2+} ions, the penetration depth in nickel was calculated to be about 280 Å. At the irradiated surface, there exists a denuded zone of ~300Å, followed by a void zone of ~400Å. Hence the void zone extends well beyond the penetration depth. The results imply that the nucleation mechanism based on displacement spikes is probably ineffective and that the irradiation could exert an appreciable heating effect in the void zone. (auth)

5706 RADIATION DAMAGE AND THE EFFECTS OF POST-IRRADIATION ANNEALING IN 1100 GRADE ALUMINIUM. Jostsons, A.; Long, E. L. (Oak Ridge National Lab., TN). Radiat. Eff.; 16: No. 1-2, 83-94(Sep 1972).

Transmission electron microscopy and immersion density measurements were used to characterize radiation damage and post-irradiation annealing effects in annealed 1100 aluminum irradiated at 45°C in an aqueous environment to maximum fluences of 3.2×10^{22} n/cm^2 (>0.1 MeV) and 3.1×10^{22} n/cm^2 (thermal). Radiation-induced swelling from voids was first detected at 7×10^{21} n/cm^2 and reached a value of 1.5% at 3.2×10^{22} n/cm^2 with a void concentration of 1.8×10^{14} /cm^3. Transmutation-produced silicon, from thermal neutron reactions with ^{27}Al, formed fine precipitate particles of approximately 5×10^{15} /cm^3, uniformly distributed throughout the matrix. Irradiation-induced swelling began to anneal out in 1 h between 110 to 170°C, with complete elimination of voids between 300 to 350°C. Subsequent annealing at higher temperatures resulted in the growth of transmutation gas bubbles and renewed swelling. No helium loss was detected in 20 h postirradiation anneals at 560°C. The activation energy for void annealing, determined from isochronal and isothermal density recovery measurements in the temperature range 170 to 300°C, was found to be in the range 1.8 to 2.0 eV. Void annealing occurred by the preferential elimination of all voids near grain boundaries as well as the smaller voids within grains. Significant void coarsening occurred within the grains before eventual elimination. (auth)

5707 SIMULATION OF DISPLACEMENT EFFECTS INDUCED IN METALS BY D–T NEUTRONS. Logan, C. M. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 15: No. 2, 631-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5708 FATIGUE CRACK GROWTH IN HELIUM-IMPLANTED, ANNEALED, AND COLD-WORKED TYPE 316 STAINLESS STEEL. Serpan, C. Z. Jr.; Smith, H. H.; Pieper, A. G. (Naval Research Lab., Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 721-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5709 OBSERVATIONS OF HELIUM BUBBLE GROWTH IN CYCLOTRON-IMPLANTED TYPE 316 STAINLESS STEEL. Smidt, F. A. Jr.; Pieper, A. G. (Naval Research Lab., Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 722-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5710 POSTIRRADIATION EXAMINATION OF COLD-WORKED AUSTENITIC STAINLESS-STEEL FUEL CLADDINGS. Challenger, K. D. (General Electric Co., Sunnyvale, Calif.); Appleby, W. K.; Wolff, U. E. Trans. Amer. Nucl. Soc.; 15: No. 2, 724-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5711 MICROSTRUCTURE OF NEUTRON-IRRADIATED SOLUTION-TREATED TYPE 316 STAINLESS STEEL. Brager, H. R.; Straalsund, J. L. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 725-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5712 ASSESSMENT OF ROOM-TEMPERATURE FRACTURE OF EBR-II CONTROL ROD THIMBLE. Miller, S. C.; Flinn, J. E.; Franklin, D. G. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 2, 726-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5713 POSTIRRADIATION MICROPROBE EXAMINATION OF A THERMIONIC CONVERTER EMITTER. Morelevat, J. P. (DMG–CENG, Grenoble, France); Lebourg, R.; Janvier, J. C. Trans. Amer. Nucl. Soc.; 15: No. 2, 728(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5714 ERROR ESTIMATION IN DAMAGE FUNCTION UNFOLDING. Odette, G. R. (University of California, Santa Barbara); McElroy, W. N. Trans. Amer. Nucl. Soc.; 15: No. 2, 728-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5715 RADIATION DAMAGE STUDIES IN Si AND Ge USING CHANNELING. Marcus, G. H. (Analytic Services, Inc., Falls Church, Va.); Olson, N. T.; Ryan, J. L. Trans. Amer. Nucl. Soc.; 15: No. 2, 731-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5716 EBR-II MATERIALS-SURVEILLANCE PROGRAM. Greenberg, Sherman (Argonne National Lab., Ill.); Strain, R. V.; Ebersole, E. R. Trans. Amer. Nucl. Soc.; 15: No. 2, 744-5 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5717 TEMPERATURE DEPENDENCE OF COPPER INFLUENCE ON RADIATION EMBRITTLEMENT SENSITIVITY OF REACTOR VESSEL STEELS. Hawthorne, J. R. (Naval Research Lab., Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 756(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5718 DUCTILITY OF SOLID LOADED IRRADIATED CLADDING. Franklin, D. G.; Miller, S. C. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 2, 773-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5719 RECOVERY OF ELECTRON-IRRADIATED PLATINUM. Pt. 4. ANNEALING IN STAGE III. Sonnenberg, K.; Schilling, W.; Mika, K.; Dettmann, K. (Kernforschungsanlage, Juelich, Ger.). Radiat. Eff.; 16: No. 1-2, 65-74(Sep 1972).

The annealing in stage III and IV of irradiated, and quenched

plus irradiated Pt samples has been studied in detail. At low defect densities the observed activation energy is equal and constant in both stages and amounts to 1.4 eV. At high irradiation induced and quenched in defect densities, a systematic variation of the effective activation energy is observed in both stages. A model which assumes vacancy migration in stage III and stage IV and which allows for partial formation and more rapid migration of divacancies is able to account for these experimental observations. Model calculations using physically reasonable values for the relevant physical parameters are able to reproduce quantitatively the experimental recovery curves and activation energies. (auth)

5720 PROPERTIES OF FREE INTERSTITIALS IN ALPHA-COPPER-ZINC ALLOYS DETERMINED DURING IRRADIATION WITH 2 MeV ELECTRONS ABOVE AMBIENT TEMPERATURE. Salamon, K.; Schuele, W. (Joint Nuclear Research Center, Ispra, Italy). Radiat. Eff.; 16: No. 1-2, 45-55(Sep 1972).

Irradiation of three partially ordered alpha-copper-zinc alloys containing 20, 30, and 36 percent Zn with 2 MeV electrons in the temperature region between 40 and 140°C caused an increase of the degree of short range order. The equilibrium state of order obtained thus depends slightly on the irradiation temperature. For the activation energy of the ordering process during irradiation an activation energy of 0.29 ± 0.03 eV was found for all three alloys. After a prolonged irradiation of the 20 percent alloy a temperature independent enhancement of diffusion was found. For the temperature-dependent diffusion a square root dependence, while for the temperature-independent diffusion a linear dependence, of diffusion rate on the electron flux was observed. These results, when compared with the theoretical predictions, suggest that the ordering rate during irradiation is determined by diffusion of interstitials. The activation migration energy of interstitials was determined to be 0.7 eV and the binding energy between interstitials and traps was found to be small, i.e., of the order of 0.1 eV. The results are in close agreement with the "two interstitial model." (auth) (UK)

5721 ACCELERATION OF RELAXATION OF STRAIN IN SILVER DURING ELECTRON IRRADIATION. Bystrov, L. N.; Ivanov, L. I.; Koveshnikov, V. G.; Platov, Yu. M. Fiz. Khim. Obrab. Mater.; No. 4, 15-17(1972). (In Russian).

Thermal and radiation relaxation of strain in high-purity silver were studied in the temperature range 30 to 130°C. Radiation relaxation was investigated during irradiation with 2.3 MeV electrons in a flux of 3.2 ± 10^{13} cm^{-2} sec^{-1}, with the result that it hastened the relaxation of strain in Ag. The kinetics of this process were controlled by the process of overcoming dislocation barriers, and is associated with radiation intensification of diffusion. (tr-auth)

Other Materials

Refer also to abstracts 5079, 5194, 5374, 5375, 5612, 5715, 6790, and 6806.

5722 (BNL-14746) CONCRETE-POLYMER MATERIALS AND POLYMER-CONCRETE COMPOSITES. Steinberg, M.; Manowitz, B.; Kukacka, L. E.; Colombo, P.; Fontana, J.; Farber, G. (Brookhaven National Lab., Upton, N. Y.). Feb 1970. 4p. (CONF-700608-38). Dep. NTIS.

From American Nuclear Society meeting; Los Angeles, Calif. (28 Jun 1970).

The compressive strength of concrete-polymer materials with different aggregates is presented. The aggregate materials include: sand, rock, soil, sewage solids, and refuse. (T.F.D.)

5723 (SC-DR-720677) FABRICATION OF BORON-REINFORCED MAGNESIUM COMPOSITES BY DIFFUSION BONDING OF PLASMA-SPRAYED MONOLAYER TAPES. Champion, A. R.; Street, H. K. (Sandia Labs., Albuquerque, N. Mex.). Sep 1972. 20p. Dep. NTIS.

The technique of diffusion bonding plasma-sprayed monolayer tapes was evaluated for making boron-reinforced magnesium composites. Procedures were developed for plasma spraying magnesium powder, and hot pressing conditions for bonding monolayer tapes were optimized. It was found that magnesium could be sprayed in air if a coarse powder (−70 +80 mesh) was used. The resulting matrix material had a total oxygen content of less than 1 weight percent, an ultimate tensile strength >20 ksi, elastic modulus of 5.2×10^6 psi, and an elongation of 4.9 to 6.3%. Void-free composites were obtained with no fiber degradation if temperatures of 565 to 575°C and pressures of 6000 to 8000 psi were used for the hot pressing operation. If temperatures above 600°C were used, severe attack of the boron filaments occurred with an accompanying loss of strength. The resulting composites were fully densified and showed good bonding between monolayer tapes. The unidirectional reinforced composites had strengths of up to 175,000 psi and moduli of up to 27.8×10^6 psi at 45 volume percent boron and followed a modified rule of mixtures behavior. (auth)

5724 (SC-DR-720706) DEVELOPMENT OF A BORSIC-ALUMINUM COMPOSITE RING STIFFENER. Hoover, W. R.; Allred, R. E.; Schuster, D. M. (Sandia Labs., Albuquerque, N. Mex.). Sep 1972. 35p. Dep. NTIS.

The feasibility of fabricating a thick-walled, Borsic filament-reinforced aluminum alloy ring for use as a stiffener in the 155mm artillery fired atomic projectile has been demonstrated and is described. The ring stiffener, which fits in the steel bulkhead under the rotating band, was produced by simultaneous circumferential filament winding and plasma spraying followed by axial compaction. Both static testing and actual gun firing confirmed that the composite ring can withstand the severe stress environment required, while effectively stiffening the projectile and producing a significant weight saving. (auth)

5725 Nd-Zn PHASE DIAGRAM. Mason, J. T.; Chiotti, P. (Ames Lab., Iowa). Met. Trans.; 3: No. 11, 2851-5(Nov 1972).

Metallographic, thermal, and x-ray techniques were used to determine the phase relations in the Nd-Zn system. Eight compounds, three eutectics and a eutectoid were found. The compounds NdZn, $NdZn_2$, and Nd_2Zn_{17} melt congruently at 923°, 925°, and 981°C respectively. The compounds Nd_3Zn_{11}, $NdZn_{4.46}$, and Nd_3Zn_{22} undergo peritectic decomposition at 870°, 902°, and 950°C respectively, while $NdZn_3$ undergoes peritectoid decomposition at 849°C. The eutectics occur at 12 wt % Zn and 630°C, 38 wt % Zn and 868°C, and 56 wt % Zn and 854°C. The eutectoid occurs at 4 wt % Zn and 622°C. The existence of a $NdZn_{12}$ phase of the $SmZn_{12}$ type structure has been confirmed. An allotropic transformation between the tetragonal $NdZn_{11}$ structure and the hexagonal $NdZn_{12}$ defect structure is proposed. (auth)

5726 STABILITY OF PLASTIC FILMS AGAINST RADIATION. IMPROVED TECHNIQUES FOR ENLARGING DEMAND. Nakagawa, T. (Industrial Products Research Inst., Tokyo). Kogyo Zairyo; 20: No. 2, 23-8(Feb 1972). (In Japanese).

Explanation is made on the stability of plastic films against low dose irradiation used for bactericidal treatment. When various plastic films were irradiated with 6 Mrad γ ray in vacuum of 10^{-6} mmHg, 0.2-85 μmoles of gases were liberated per g of plastic resin. The least was from polyamide, followed by polystyrene, chloromethylated polyether, polychlorinated ethylene trifluoride, polyester, polycarbonate, Nylon 66, Nylon 11, polychlorovinylidene, polyethylene, and polyether in this order. Components of the gases were CO_2, CO, N_2, NO, SO_2, H_2S, H_2, and various hydrocarbons. Presence of benzene rings in molecules stabilizes synthetic resins against irradiation. Therefore, trial has been made to strengthen various chain polymers by introduction of the benzene rings into the molecular structure. For example, phenyl radical was introduced in the chain of polydimethylsiloxane. Increase of viscosity did not appear even by the irradiation of 50 to 80 Mrad after the introduction. Poly(vinyl chloride) was also stabilized by addition of N-methyldithiocarbamate into the chain. Polystyrene is very strong against irradiation, but its use is restricted because of its physical properties. (Japan)

5727 PRODUCTION OF UO_3, UO_2, AND UF_4. Rodrigo Otero, A.; Gonzalez Garcia, V. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 16: No. 77, 333-53(1972). (In Spanish).

The JEN has developed a pilot plant for the production of UF_4 using the direct thermal decomposition of the nitrate to UO_3, followed by reduction to UO_2 and fluoridation to UF_4. The physical chemistry of the process is outlined. The production operations are described in some detail. The principal technical problems encountered are described. The characteristics of the product obtained are given. Problems to be solved in the conversion to industrial-scale operation are indicated. (J.S.R.)

5728 GLASS MACHINING BY ION SPUTTERING. Bayly, A. R.; Townsend, P. D. (Univ. of Sussex, Brighton, Eng.). J. Phys., D (London); 5: No. 11, L103-4(Nov 1972).

A beam of nitrogen ions was used to machine a 15-μm-deep groove in a 25-μm-thick glass plate. The ion-beam machining produced the desired optical finish on the base of the trench. (auth)

5729 IMPROVEMENTS IN OR RELATING TO GLASS. (to Carl-Zeiss-Stiftung). British Patent 1,286,228. 23 Aug 1972. Priority date 6 Mar 1970, Germany.

Reference is made to glass compositions with very low inherent radioactivity, such as is required in the conduct of radiochemical operations and for radiation measuring instruments. In addition the glass should have high light transmission in the visible and short wave range, good devitrification resistance, and good workability. The glass described is borosilicate and free from K_2O, and is melted from a batch having the compositions SiO_2 65 to 66, B_2O_3 12, Al_2O_3 5, Na_2O 6 to 6.5, ZnO 5 to 8, and BaO 3 to 6 parts by weight, with the provision that ZnO + BaO = 11, with the addition of 0.05 to 0.15 parts of reducing agent such as sugar or powdered wood charcoal, and also refining agents comprising not more than 0.3 parts NaCl and not more than 0.20 parts of F introduced as Na_2SiF_6. (UK)

5730 CONCRETE-POLYMER MATERIALS AND SOLID-WASTE POLYMER COMPOSITES. Steinberg, M.; Manowitz, B. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 2, 700-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5731 FAST AND SLOW DIFFUSION OF BARIUM IN REACTOR-GRADE GRAPHITE. Skerker, A. L. (Corps of Engineers, Alexandria, Va.); Zumwalt, L. R. Trans. Amer. Nucl. Soc.; 15: No. 2, 760-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

5732 (ARH-SA-145) TRACE ANALYSES AND NONDESTRUCTIVE ANALYSES FOR SAFEGUARDS APPLICATIONS AND ENVIRONMENTAL SAMPLES. Colvin, C. A. (Atlantic Richfield Hanford Co., Richland, Wash.). 24 Oct 1972. Contract AT(45-1)-2130. 5p. (CONF-721025-12). Dep. NTIS.

From 16th conference on analytical chemistry in nuclear technology; Gatlinburg, TN. (24 Oct 1972).

Nondestructive gamma energy analysis using lithium-drifted germanium [Ge(Li)] detectors designed for the sample type and configuration has been applied over a wide range of samples. On the one hand, environmental analyses on solid materials containing less than naturally occurring background radiation can be handled, while at the other extreme, flux monitor wires with radiation higher than 500 rems are analyzed. Systems for interrogating packages containing plutonium metal, plutonium oxides, solutions, or simple packages of waste are also illustrated. (auth)

5733 (BNL-17165) CATALOGUE OF NUCLEAR MATERIAL SAFEGUARDS INSTRUMENTS. Kull, L. A. (Brookhaven National Lab., Upton, N. Y.). Aug 1972. 54p. Dep. NTIS.

This catalog of data sheets on nuclear materials assay instrumentation provides a concise review of assay instrumentation presently in operation throughout the nuclear industry. The catalog is divided in three parts. Section A includes assay instruments for pellets, pins, rods, and plates. Section B includes instruments for packages, boxes, and containers of less than 5 gal capacity. Section C includes instruments for drums, boxes and containers of more than 5 gal capacity. Each data sheet gives the name, developer, principle of measurement, design and operation, and operating history of the assay instrument. References to further information on the instrument are also given. Where more than one class of sample can be assayed by a single instrument, cross references are included. (T.F.D.)

5734 STATUS OF THE IAEA'S FIELD EXPERIENCE IN NONDESTRUCTIVE MEASUREMENTS OF LOW ENRICHED URANIUM. Dragnev, T. (International Atomic Energy Agency, Vienna). Trans. Amer. Nucl. Soc.; 15: No. 2, 670(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5735 RANDOM SOURCE INTERROGATION SYSTEM FOR NONDESTRUCTIVE ASSAY OF FISSIONABLE MATERIALS. Foley, J. E. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 670-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5736 COMPARATIVE ASSESSMENT OF NONDESTRUCTIVE ASSAY CAPABILITIES AND MATERIAL PROTECTION OBJECTIVES. Shea, T. E. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 671(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5737 FISSILE ASSAY OF SMALL SAMPLES BY SUBTHRESHOLD NEUTRON INTERROGATION. Evans, A. E.; Thorpe, M. M.; Malanify, J. J. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 673(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5738 GAMMA MEASUREMENTS ON SPENT FUEL ELEMENTS. Beets, C. (SCK/CEN, Mol, Belg.); Dragnev, T.; Hecq, R. Trans. Amer. Nucl. Soc.; 15: No. 2, 673-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5739 EFFECT OF INDUCED FISSION ON PLUTONIUM ASSAY WITH A NEUTRON COINCIDENCE WELL COUNTER. Perry, R. B.; Brandenburg, R. W.; Beyer, N. S. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 674-5 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5740 COMPUTERIZED SAFEGUARDS AND ACCOUNTABILITY SYSTEM. Lawless, J. L.; Barton, H. N.; Harlan, R. A. (Dow Chemical Co., Golden, Colo.). Trans. Amer. Nucl. Soc.; 15: No. 2, 675-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5741 TESTS OF AN ELECTRON MICROTRON FOR NUCLEAR MATERIALS ASSAY APPLICATIONS. Kull, L. A. (JRB Associates, La Jolla, Calif.); Zucker, M. S.; Thompson, A. S.; Froelich, H. R. Trans. Amer. Nucl. Soc.; 15: No. 2, 676 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5742 PLUTONIUM MATERIAL BALANCE ACCOUNTING UTILIZING NONDESTRUCTIVE ASSAY MEASUREMENTS. Wadekamper, D. C.; Bishop, D. M.; Hagie, L. T. (General Electric Co., Sunnyvale, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 677-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5743 NONDESTRUCTIVE ANALYSIS OF FUEL PINS IN THE ARMF. Stepan, I. E.; Allard, N. F.; Simpson, F. B. (Aerojet Nuclear Corp., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 2, 678(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5744 ISOTOPIC NEUTRON SOURCE SYSTEM FOR THE ASSAY OF PLUTONIUM FUEL RODS. Menlove, H. O.; Forster, R. A.; Parker, J. L.; Smith, D. B. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 678-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5745 NONDESTRUCTIVE FERTILE AND FISSILE MATERIAL ASSAY OF THE Th-U FUEL PEBBLES. Krappel, W.; Stegemann, D. (Univ., Hanover). Trans. Amer. Nucl. Soc.; 15: No. 2, 679-80(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5746 PERFORMANCE OF A PELLET-TO-PELLET ^{252}Cf FUEL ROD ASSAY SYSTEM. Forster, R. A. (Los Alamos Scientific Lab., N. Mex.); Menlove, H. O.; Parker, J. L; Forehan, H. M. Jr. Trans. Amer. Nucl. Soc.; 15: No. 2, 680-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5747 RELATIVE MEASUREMENTS OF BURNUP AND PLUTONIUM CONTENT IN PWR ASSEMBLIES. Bannella, R. (ENEL, Rome); Giuriato, A.; Paoletti Gualandi, M.; (and others). Trans. Amer. Nucl. Soc.; 15: No. 2, 681-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5748 METHOD FOR COMPLETE NONDESTRUCTIVE ASSAY OF PLUTONIUM IN SCRAP AND ASH SAMPLES. O'Hara, F. A.; Strohm, W. W.; Haas, F. X. (Monsatonto Research Corp., Miamisburg, Ohio). Trans. Amer. Nucl. Soc.; 15: No. 2, 682 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5749 INSPECTOR INSTRUMENTATION FOR REAL-TIME NONDESTRUCTIVE ASSAY. Cline, J. E.; Heath, R. L. (Aerojet Nuclear Corp., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 2, 682-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5750 OPERATIONAL EXPERIENCE WITH THE AUTOMATIC LEAD SPECTROMETER FACILITY FOR NUCLEAR SAFEGUARDS. Krinninger, H.; Ruppert, E. (Interatom, Bensberg, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 2, 683-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D.C. (12 Nov 1972).SeeCONF-721109.

5751 COMPUTERIZED NONDESTRUCTIVE NEUTRON INTERROGATION TECHNIQUE FOR SAFEGUARDS APPLICATION. Eberle, R.; Zeller, M. (Univ., Hanover). Trans. Amer. Nucl. Soc.; 15: No. 2, 798-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5752 IMPLEMENTATION OF INTERNATIONAL SAFEGUARDS: BACKGROUND AND FUTURE. Rometsch, R. (In-

ternational Atomic Energy Agency, Vienna). Trans. Amer. Nucl. Soc.; 15: No. 2, 989(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5753 RELATIONSHIP OF INTERNATIONAL AND DOMESTIC SAFEGUARDS. Crowson, D. L. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 989-90(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5754 EVALUATION OF INTERNATIONAL SAFEGUARDS AND THEIR IMPACT ON THE NUCLEAR INDUSTRY. Willrich, M. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 15: No. 2, 990-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Disposal and Storage

Refer also to abstracts 5224, 5483, and 5730.

5755 (COO-1057-59) RADIOACTIVE WASTE DISPOSAL, A SUGGESTION FOR A PERMANENT INTERNATIONAL POLAR HIGH-LEVEL RADIOACTIVE WASTE REPOSITORY. Zeller, E. J. (Kansas Univ., Lawrence (USA). Space Technology Labs.); Saunders, D. F. (Texas Instruments Inc., Dallas). Apr 1972. 36p. Dep. NTIS.

Based upon a preliminary study, it is suggested that radioactive wastes be placed under the ice cap in Antarctica (or possibly Greenland). All available evidence indicates that if the wastes were converted to solid glass cylinders, they could be practically and safely transported to the interior of the ice cap. If placed on the surface of the ice, they would melt their own emplacement shafts which would rapidly reseal by freezing and plastic flow. The cylinders would sink to the ice-rock interface where they would remain safely isolated from the biosphere for more than 10,000 to 100,000 years. Scientific studies have indicated that the average temperature in Antarctica has remained below freezing for more than a million years so that the large thickness of polar ice may be expected to provide a good seal for at least a similar period into the future. Tentatively selected disposal sites are 400 to 500 miles inland from the nearest natural flora or fauna, isolated from the sea by mountain ranges as well as long horizontal thicknesses of ice and frozen ground. The sites were selected to effectively eliminate the chance of any harmful effects due to ice movements. A brief comparison of the ice cap approach with other suggested methods of ultimate disposal indicates that it holds much promise of being the most practical and safest solution to the problem, and it deserves early and careful consideration by both the appropriate U. S. and international agencies. (T.F.D.)

5756 (FRNC-CONF-32) STORAGE, STABILIZATION, AND UTILIZATION OF INDUSTRIAL MINERAL WASTES. Brandela, M. (Centre de Documentation Mineralurgique, Paris (France)). 1972. 10p. (In French). (CONF-720454-3). Dep. NTIS (U. S. Sales Only).

From Meeting of the Mineral Section on problems posed by wastes arising from the processing of ores; Paris, France (19 Apr 1972).

The methods used to store the solid wastes from mineral washing processes and the utilization of such wastes are presented. The disposal of solid radioactive wastes was examined. Problems concerning the disposal of liquid wastes are reviewed: the injecting of effluents into deep underground strata; the treatment of used waters (solid–liquid separation with possible coagulation), chemical methods, magnetic and electrical processes, purification by flotation, biological processes, analytical control of waste waters; and the reuse of used water by recycling or by recovery of the useful elements. The principal types of precipitators used to reduce the gaseous wastes released to the atmosphere are described. (France)

5757 (ICP-1011) SAFETY ANALYSIS FOR MODIFICATIONS OF ICPP DISSOLVER AND VESSEL OFF-GAS SYSTEMS. Chamberlain, H. V. (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs Operations Office). Oct 1972. Contract AT-(10-1)-1375. 25p. Dep. NTIS.

Modifications to the off-gas systems at ICPP that have been made to minimize the release of particulate activity to the atmosphere from the existing dissolver and vessel off-gas systems are described. The generation of airborne activity occurs, primarily, during the dissolution of fuel elements. Systems for reducing the activity released to the stack have been installed on the two dissolver off-gas (DOG) systems from the aluminum and the zirconium fuel dissolution processes and on the vessel off-gas system (VOG). Each of the three cleanup systems consists of a deentrainment vessel to remove water droplets entering with the off-gas, a heater to superheat the gas above its dew point, and a high efficiency filter to remove the remaining particulate activity in the gas stream. (auth)

5758 (ORNL-TM-3976) TRITIUM ENRICHMENT BY ISOTOPE SEPARATION TECHNIQUE. Lin, K. H. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 33p. Dep. NTIS.

A preliminary evaluation of six isotope separation techniques has been carried out to assess their technical and economic feasibility in decontamination of tritiated water containing a trace amount of tritium ($\gg 10^{-3}$ μCi/ml). The isotope separation technique segregates the tritiated water into the tritium-enriched portion that can be subject to long-term tank storage, and the tritium-depleted portion which may be discharged to surface drainage. The flow rate of the tritiated-water feed to the isotope separation plant was assumed to be approximately 460,000 gal per day with a tritium content of ~0.14 μCi/ml. Two methods that have potential technical and economic feasibility are the dual-temperature water-H_2S exchange process and the cryogenic hydrogen distillation process. (auth)

5759 (ORNL-TM-4004) CONCEPTUAL DESIGN REPORT FOR THE PROPOSED ORNL PROCESS WASTE TREATMENT PLANT. Braatz, R. J. (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 83p. Dep. NTIS.

A construction project has been proposed to provide better treatment facilities for the low-level radioactive, or process waste collected at Oak Ridge National Laboratory. This waste stream, averaging approximately 150 g/min contains about 0.3 μCi/gal of beta-gamma activity with traces of alpha activity. The present lime-soda treatment facility, which achieves a decontamination factor of only 4 to 5, would be replaced with a much more efficient process utilizing ion exchange following a head-end scavenging step. The conceptual design for this new facility including a detailed description, justification, outline specifications, the proposed schedule and cost estimates is presented. Nineteen conceptual design drawings are included. (auth)

5760 BARNWELL NUCLEAR FUEL PLANT. Newman, R. I. (Allied-Gulf Nuclear Services, Florham Park, NJ). Nucl. Eng. Int.; 17: No. 198, 938-41(Nov 1972).

The Barnwell reprocessing plant with a capacity of 5 tons per day is designed for light-water reactor fuels. It is based on the Purex process and will use the chop-leach head end, incorporating a larger shear than previously manufactured and an improved dissolver system. Valence is controlled by a novel electrochemical method using electropulse columns and carried out in a heterogeneous mixture of aqueous and organic components. The plant incorporates unusually high safety features several of which are discussed. Notable aspects are the absence of radioactive material in the cooling water and pond water, the highly-efficient gaseous effluent plant, methods of handling and storing radioactive waste, and an intensive monitoring program. (UK)

5761 WASTE MANAGEMENT AND SITING IN THE FUEL CYCLE. Pittman, F. K. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 598(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5762 COST POTENTIAL FOR REDUCING TRITIUM ACTIVITY IN AQUEOUS EFFLUENTS. Leonard, J. H.; Kueck, J. J. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 15: No. 2, 653-4 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5763 ENVIRONMENTAL EVALUATION OF EXTENDED RADWASTE TREATMENT SYSTEMS: TVA NUCLEAR POWER PLANTS. Gartrell, F. E.; Stone, G. F.; Roberts, B. F. (Tennessee Valley Authority, Chattanooga). Trans. Amer. Nucl. Soc.; 15: No. 2, 661-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5764 NUCLEAR BY-PRODUCT LONG-TERM HEAT GENERATION RATES. Angelo, J. A. Jr.; Post, R. G.; Haskin, F. E.; Lewis, C. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 15: No. 2, 663-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5765 AIR-COOLED CONCRETE VAULTS FOR THE STORAGE OF HIGH-LEVEL SOLIDIFIED WASTES. Perona, J. J. (Univ. of Tennessee, Knoxville); Blomeke, J. O. Trans. Amer. Nucl. Soc.; 15: No. 2, 664-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Handling Equipment and Procedures

Refer also to abstracts 4919, 5219, and 6933.

5766 (ARH-SA-77) SAFE FISSILE MATERIAL SPACING IN WATER. Carter, R. D. (Atlantic Richfield Hanford Co., Richland, Wash.). 15 Oct 1970. Contract AT(45-1)-2130. 17p. (CONF-701102-26). Dep. NTIS.

From Meeting of the American Nuclear Society; Washington, D. C. (15 Nov 1970).

Aspects of safe fissile material spacing for storage in water are discussed. It is noted that safe storage of reactor fuel up to at least 6.6% enrichment requires that storage density limitations be established for each type of fuel stored. The use of curves for estimating reactivity is examined along with results of calculations for a number of subcritical units. (J.R.D.)

5767 (BNWL-B-221) PAPERS ON A HOT CELL FIRE AND VENTILATION STUDY: A NORCUS SUMMER PROJECT. Oster, C. A. (ed.) (Battelle Pacific Northwest Labs., Richland, Wash.). Sep 1972. Contract AT(45-1)-1830. 68p. Dep. NTIS.

Activities in programs directed to examination of simulated fire test facilities for hot cells are summarized. An experimental fire test facility being used in the project is diagrammed and described. Progress reported in the project includes results of a literature search and results of fuel evaporation studies. It is noted that the project has not achieved a smoothly operating simulation system. (J.R.D.)

5768 (CEA-CONF-2055) ELEMENTS OF ACCOUNTING IN OPERATION OF A HOT LABORATORY. Hayet, Lucien; van Craeynest, Annick (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1971. 20p. (In French). (CONF-720649-3). Dep. NTIS (U. S. Sales Only).

From 14th Committee of Hot Laboratories of EURATOM; Petten, Netherlands (8 Jun 1972).

It is noted that it is necessary to establish analytical costs for high-activity laboratories. Establishment of such costs is not easy because it depends on many parameters that must be taken into consideration. On the basis of experience gained at the radiometallurgical laboratory during 1971, important accounting factors for operation are outlined. Reasons for selection of these factors are given. (tr-auth)

5769 (NBL-265, pp 104-7) SAFE STORAGE OF PLUTONIUM SOLUTIONS. Weiss, J. R.; Pietri, C. E. Oct 1972.

In Annual progress report for the period July 1971-June 1972.

The New Brunswick Laboratory plutonium solution storage assembly was evaluated with respect to adequate venting of hydrogen which is produced as a product of radiolysis. Various size vents were considered and the rate at which hydrogen can be safely released from each was calculated. (auth)

5770 GRAB FOR HANDLING OF NUCLEAR REACTOR FUEL ELEMENTS. Papaczek, F.; Bernhard, E. (to Maschinenfabrik Augsburg-Nuernberg AG). German Patent 1,284,526. 18 May 1972. (In German).

A description is given of a gripping device for vertical standing fuel elements for a reactor to be loaded from the bottom, the fuel elements carrying a grip head on the top end. The fuel element grip head is locked by means of a special sliding ball bearing inside the grip capsule, so that the fuel element can be unlocked only by taking over the load by a suspension device. (GF)

5771 SPENT-FUEL SHIPPING SYSTEM FOR LARGE HTGR PLANTS. Davis, C. R.; Granich, B. R. (Gulf General Atomic Co., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 666 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5772 HIGH-CAPACITY CRITICALLY SAFE CENTRIFUGAL CONTACTOR. Bernstein, G. J.; Levitz, N. M.; Lenc, J. F.; Grosvenor, D. E. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 666-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5773 CRITICALITY CONTROL PARAMETERS FOR DISCHARGED FUEL. Toffer, H.; Miller, R. L. (Douglas United Nuclear, Inc., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 802-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5774 CRITICALITY OF PLUTONIUM-URANIUM NITRATE SOLUTIONS. Lloyd, R. C.; Clayton, E. D.; Bierman, S. R. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 803-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5775 CRITICAL PARAMETER CALCULATIONS WITH HIGH-BURNUP PLUTONIUM SOLUTIONS. Carter, R. D. (Atlantic Richfield Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 804-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5776 CRITICALITY EXPERIMENTS OF LWR MIXED OXIDES AT 20 H:Pu+U. Bierman, S. R.; Clayton, E. D. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 805-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5777 CRITICALITY SAFETY OF SOME WATER-SPRINKLED NONCUBIC ARRAYS. Handley, G. R. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 806-7 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5778 DOUBLE BATCHING CELL LOADINGS IN STORAGE ARRAYS. Thomas, J. T. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 807-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

PARTICLE ACCELERATORS

Auxiliaries and Components

Refer also to abstract 5812.

5779 (BNL–17219) MAGNETIZATION EFFECTS IN SUPERCONDUCTING MAGNETS. Parzen, G.; Jellett, K. (Brookhaven National Lab., Upton, N. Y.). 14 Sep 1972. 6p. Dep. NTIS.

The computed results for field multipoles generated by magnetization effects in superconductors are compared with the measured results for the 14 in. model. Computed results are given for the proposed 3 ft model. (auth)

5780 (BNL–17221) DC SUPERCONDUCTING BEAM SPLITTING MAGNET SYSTEM. Hsieh, H.; Britton, R.; Gibbs, R.; Grisoli, J.; Kapfer, H. (Brookhaven National Lab., Upton, N. Y.). [nd]. 7p. (CONF-720908–14). Dep. NTIS.

From fourth international conference on magnet technology; Upton, NY. (19 Sep 1972).

A dc superconducting beam splitting magnet was fabricated and tested at BNL. This component will be used to deflect high intensity protons onto two target stations during the same AGS pulse. The magnet system, the cryostat and the refrigerator are described in detail. Initial fabrication difficulties are presented, and test results are included. (auth)

5781 (BNL–17228) LARGE HELIUM SYSTEMS FOR SUPERCONDUCTING POWER APPLICATIONS AND HIGH ENERGY PHYSICS. Jensen, J. E. (Brookhaven National Lab., Upton, N. Y.). [nd]. 17p. (CONF-721023–2). Dep. NTIS.

From Conference of the Cryogenic Society of America; Chicago, IL. (3 Oct 1972).

Two areas of applied superconductivity are considered: the transmission of large blocks of electric power and the construction of high-field magnets to be used to extend the energy of particle accelerators. Both of these applications will require helium-temperature refrigerators, as well as rather large quantities of helium in inventory. Examples of several systems for each application are given, with reasons for selection and the advantages and disadvantages. Also included is a discussion of helium refrigerators with the effects of the transport properties of helium on efficiencies of such machines in several pressure–temperature regions. (3 figures, 2 tables) (R.W.R.)

5782 (LA–5076) ELECTRO-MECHANICAL TOLERANCE REQUIREMENTS FOR QUADRUPOLES FROM THE BEAM OPTICAL ABERRATIONS. Vogel, H. F. (Los Alamos Scientific Lab., N. Mex.). Nov 1972. Contract W-7405-eng-36. 39p. Dep. NTIS.

The description of the trajectories as a Taylor's expansion uses a Green's function that contains only the first-order trajectories. These are computed by TRANSPØRT and then used by the output program HIGHØRD, which compares the high order perturbations of trajectories with the distortions of the quadrupole field from four types of electro-mechanical perturbations. (auth)

5783 (LAL-RI–72-4) SYNCHROTRON RADIATION OF HIGH-ENERGY ELECTRONS: USEFUL FORMULAE AND POSSIBLE APPLICATIONS. d'Almagne, B. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Apr 1972. 11p. Dep. NTIS (U. S. Sales Only).

The formulation of important results concerning synchrotron radiation is presented. Various applications in the field of high energy physics are considered: separation of electrons from heavier charged particles, electron detection, and high intensity electron beam monitoring. (France)

5784 (SC-DR–720506) 3-MEGAVOLT SULPHUR HEXAFLUORIDE TRIGATRON. Tucker, W. K. (Sandia Labs., Albuquerque, N. Mex.). Sep 1972. 32p. Dep. NTIS.

A triggered, single-channel, sulfur hexafluoride dielectric, 3-megavolt trigatron has been designed, constructed, and tested for use on the Hydra electron beam machine. The design details and test results are reported. (auth)

5785 MAGNETS FOR RADIATION-RESISTANT ACCELERATORS. Gresham, A. T.; Sheldon, R.; Stapleton, G. B. (Rutherford High Energy Lab., Chilton, Eng.). Particle Accel.; 4: No. 1, 43-51(Oct 1972).

The problem of radiation damage likely to be met with in particle accelerator installations is discussed and methods of protection based on the total exclusion of radiation sensitive materials are considered. The use of mineral insulation for magnets is explored and a detailed description of a number of actual prototype magnets is included. (auth)

5786 DESIGN OF A HIGH-INTENSITY, HIGH-ENERGY BEAM DUMP. Awschalom, M.; Van Ginneken, A. (National Accelerator Lab., Batavia, Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 970(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5787 PHOTON DOSE RATES FROM THE INTERACTIONS OF 200-GeV PROTONS IN Fe AND Fe–Pb BEAM STOPS. Santono, R. T.; Gabriel, T. A. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 970-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Ion Sources and Injection and Extraction Systems

Refer also to abstract 5808.

5788 (BNL–17159) HIGH INTENSITY PROTON SOURCES FOR HIGH ENERGY ACCELERATORS. Sluyters, T. (Brookhaven National Lab., Upton, N. Y.). [nd]. 20p. (CONF-720948–6). Dep. NTIS.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

A review is presented on the present performance of the ion sources in the world's largest proton linacs and proton synchrotrons installed in the following laboratories: National Accelerator Laboratory (Batavia, USA), Rutherford High Energy Laboratory (Chilton, England), CERN (Geneva, Switzerland), Los Alamos Scientific Laboratory (Los Alamos, USA), Centre d'Etudes Nucleaire (Saclay, France), Institute for High Energy Physics (Serpukhov, USSR), Brookhaven National Laboratory (Upton, USA), and Institute of High Energy Physics (Tsukuba, Japan). (auth)

5789 (DESY–72/49) MEASUREMENT OF THE BUNCH STRUCTURE IN THE DESY SYNCHROTRON. Fischer, R.; Rossmanith, R. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug 1972. 9p. Dep. NTIS (U. S. Sales Only).

A sampling technique is described which allows the investigation of the bunch structure, sampled over several bunches, by means of synchrotron light at the DESY 7 GeV Synchrotron. The sampling method works well only when all bunches are equally filled, when they have equal length, and when they do not oscillate. (F.S.)

5790 (LBL–1219) PERFORMANCE CHARACTERISTICS OF A COMPACT SELF HEATED CATHODE SOURCE AND ANALYZER FOR THE BERKELEY 3-MV SUPERHILAC INJECTOR. Gavin, B. F. (California Univ., Berkeley. Lawrence Berkeley Lab.). Aug 1972. Contract W-7405-eng-48. 12p. (CONF-720948–2). Dep. NTIS.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

A PIG discharge, designed for the production of multiply charged ions for operation in the Berkeley SuperHILAC 3-MV injector and operating in a magnetic gap of 5.8 cm at 2000–4500 gauss, has been studied in conjunction with and inseparable from a 123° analyzer. Results reported were made with a test magnet. Analyzed ion beams have been rendered by varying beam energy, and magnetic field of both analyzer and source. Inert gaseous ion yields are reported, as are the ion source arc characteristics. A fast pulsing gas valve is also described. Effort has been directed towards the ionization of solid materials to a charge to mass ratio of ≥0.04. 7.2 μA of gold^{10+} and at least 11 μA of germanium$^{4+}_{76}$ has been analyzed and measured. (auth)

5791 EXTRACTION OF PARTICLES FROM A COMPACT ISOCHRONOUS CYCLOTRON. van Nieuwland, J. M. (Technical Univ., Eindhoven, Netherlands). Philips Res. Rep. Suppl.; No. 2, 1-88(Apr 1972).

Thesis.

The different phenomena that play a role in the process of extracting the particles from a Compact Isochronous Cyclotron are investigated. The main factors which determine the efficiency of the extraction are: (1) the behavior of the particles before they are extracted, and (2) the mechanism which deflects the particles. The important parameters describing the orbital behavior of the particles in an isochronous cyclotron are introduced, followed by a technical description of the Compact Isochronous Cyclotron and the extraction mechanism used. The motions which the particles

perform in the horizontal plane with respect to an undisturbed (ideal) particle orbit can be regarded as the motions of the orbit center. Using this representation an analytical theory is developed which describes the influences of disturbances in the magnetic field on the particle motion. A first-harmonic magnetic-field component and a combination of first- and second-harmonic magnetic-field components are disturbances which can be used successfully to obtain a sufficient separation of the last particle orbits before deflection. This separation is necessary to optimize the extraction efficiency. The addition of a second-harmonic component has several advantages: it increases the extraction efficiency, it enhances the quality of the extracted beam, improves the flexibility of the extraction system and reduces the sensitivity to disturbances at the initial acceleration. The analytical calculations are compared with the results of numerical particle-orbit integrations and verified by a large number of extraction experiments. A very good agreement is obtained in most cases. (auth)

5792 BRIGHTNESS OF HOLLOW CYLINDRICAL ION BEAM. Becherer, R.; Prevot, F. (CEN, Fontenay-aux-Roses, France). Nucl. Instrum. Methods; 104: No. 3, 477-84(1972). (In French).

The plane beam coming from an annular magnetron type ion source is transformed into a hollow cylindrical beam with an inhomogeneous electrostatic deflecting field. The azimuthal velocity of the ions is made equal to zero by compensating the internal magnetic flux of the source. The brightness of the beam has been calculated and measured. In typical conditions, for a H_2^+ current of 20 mA at 80 cm of the source energy dispersion $\Delta E/E \leq 30\%$, mean energy 18 keV, the normalized brightness is $B_N = 5.95 \times 10^8$ A/π(rad m^2). Maximum current of the beams is 70 mA. (auth)

5793 DEVELOPMENTS OF AN ELECTROSTATIC ION GUN FOR SPECIMEN THINNING. Fitch, R. K.; O'Shea, K. R.; Rushton, G. J. (Univ. of Aston, Birmingham, Eng.). pp 296-7 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From 5th European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

An electrostatic ion source has been developed for the preparation of specimens for electron microscopy by ion etching. This is based on an electrostatic charged-particle oscillator and consists of a cylindrical cathode surrounding two tungsten wire anodes. Electrons oscillate between the anodes so that a cold-cathode discharge can be maintained down to pressures of about 10^{-6} torr. The discharge is concentrated about an axial plane normal to the plane of the anodes and the resulting ions are allowed to escape through an aperture in the cathode. Ion densities of 100 μA/cm^2 have been obtained with the anodes at 6 kV at a pressure of 5×10^{-4} torr. An improved version of this source is described that is more reliable in operation; the spring-loaded anode wires have been replaced by 2-mm-diameter tungsten rods. Recent developments in the design and operation of the source are described. (UK)

5794 FACETED STRUCTURES FORMED DURING ION THINNING. Moss, M. A.; Steeds, J. W. (Univ. of Bristol, Eng.). pp 298-9 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From 5th European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

An ion-beam thinning machine was built that differed from commercial machines in having a three-electrode ion gun. The ions are formed by glow discharge in one section of the gun and accelerated in the other section, resulting in the production of a highly collimated high-current beam. Typical beam currents are 50 μA at 8 keV, with current densities >10 μA/mm^2. The design resulted in much lower cathode erosion. During trials of the machine with single-crystal Ag–Zn specimens, scanning micrographs of the ion-etched surfaces showed some remarkably regular faceted structures, and two features were particularly noticeable: the first was the occasional formation of what appeared to be regular six-faced peaks, and the second was the occurrence of double-faceted peaks apparently mirror related to each other in a (110) plane. Comparisons are made with sputtering data. The apparatus is being used to prepare electron-transparent flakes of breaking oxide. (UK)

Ion Optics and Field Calculations

5795 (AEC-tr-7380) STRUCTURE OF THE SPACE CHARGE FIELD OF AN ELLIPSOIDAL CLUSTER OF CHARGED PARTICLES. Lysenko, O. E.; Khizhnyak, N. A. (Akademiya Nauk Ukrainianskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). Translated from report KHFTI-70-32. 11p. Dep. NTIS.

The solution of the equations of motion of the accelerated particles in strong-current linear accelerators considering the effect of the forces of the volumetric charge requires knowledge of the structure of the internal fields for different configuration of the accelerated cluster and different particle distribution with respect to the volume. A study is made on the volumetric charge field of an ellipsoidal plasmoid and a plasmoid which is similar to it with respect to configuration where the charge density varies with respect to a power law. The volumetric potentials of the ellipsoid of rotation are calculated for linear, quadratic and cubic distribution of the charge density. (auth)

5796 (BNL-17168) COIL CONFIGURATIONS IN SUPERCONDUCTING DIPOLES AND QUADRUPOLES. Parzen, G.; Jellett, K. (Brookhaven National Lab., Upton, N. Y.). [nd]. 8p. (CONF-720908-11). Dep. NTIS.

From 4th international conference on magnetic technology; Upton, NY. (19 Sep 1972).

The limitations on the good-field aperture of superconducting dipoles due to approximating the cos θ current distribution using a finite number of ribbon-shaped conductors arranged in blocks are investigated. Results are presented for the good-field aperture limit due to the choice of the number of blocks per quadrant. Results are also presented for several ribbon configurations having 5, 6, and 7 blocks per quadrant, for which the lower undesired multipoles are eliminated by using either slight azimuthal displacements of the block or special multipole correction windings. A similar study is also made for quadrupoles having a cos 2θ current distribution. Results are given for quadrupoles having 2 and 3 blocks per octant. (auth)

5797 (BNL-17175) PERTURBATION METHOD FOR cos θ MAGNET WITH NONLINEAR IRON SHIELD. Abeshouse, D.; Hahn, H. (Brookhaven National Lab., Upton, N. Y.). [nd]. 6p. (CONF-720908-4). Dep. NTIS.

From fourth international conference on magnet technology; Upton, NY. (19 Sep 1972).

Nonlinearities of the iron in high-field magnets are usually treated by the aid of mesh-type computer programs. An alternate approach using a quasi-analytical method is suggested. Since the field-current relationship of a cos θ magnet deviates even at 40 kG only by a few percent from a linear law, the nonlinearities are treated as a perturbation of the infinite-permeability case. The method is limited to a geometry with rotational symmetric iron shield. The application of this method to an actual magnet is in progress, but a definite statement as to its accuracy is not yet possible. (auth)

5798 (LA-DC-72-1121) COMPUTATION OF MAGNETIC END FIELDS, AND COMPARISON WITH MEASUREMENT. Vogel, H. F. (Los Alamos Scientific Lab., N. Mex.); Lari, R. J. (Argonne National Lab., Ill.). [nd]. 8p. (CONF-720908-13). Dep. NTIS.

From fourth international conference on magnet technology; Upton, NY. (19 Sep 1972).

The dependence of the magnetic effective length and the fringe-field correction constant on the central field flux density are of particular interest in designing beam transport systems. It is therefore important to know the accuracy with which they may be calculated. Measurements on Argonne's bending magnet BM-111 have been compared with TRIM computations. The agreement between computed and measured effective lengths was within 1.7 percent in pole separation units for fields from 0 to 17 kG. The agreement between computed and measured fringe field correction constant, which determines the correction angle to the transverse focal length, was within 0.56 percent of the measured value of 8 kG. (auth)

5799 (SC-TM-720568) ELECTRON BEAM FOCUSING: RULES OF THUMB. Zuppero, A. C. (Sandia Labs., Albuquerque, N. Mex.). Sep 1972. 27p. Dep. NTIS.

A few simple rules of thumb are shown which allow one to estimate electron beam focusing and transport parameters under the most optimistic and favorable conditions. Some inequalities are presented which allow the statement "the following should certainly not work." In addition, some simple scaling rules and simple concepts are discussed. (auth)

5800 (UCRL-Trans-1487) ADIABATIC PROCESSES IN A SPIRAL MAGNETIC FIELD. Bonch-Osmolovskii, A. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated for Univ. of California, Lawrence Berkeley Lab., Berkeley, from report JINR-P9-6464. 14p. Dep. NTIS.

In a preceding work it was noted that when electrons revolve in a weakly focusing magnetic field the betatron oscillation frequencies are considerably affected if an azimuthal component of the magnetic field is introduced. It was postulated that if a charged

ring is formed in such a field its small dimensions can be appreciably changed. Recently it has been shown that under certain conditions in a spiral weakly focusing field the conditions of passing dangerous one-particle resonances on ring compression are greatly improved. The aim of the present work was to study, within the framework of the problem with a self-consistent field, the behavior of a charged electron ring in a spiral magnetic field varying adiabatically in time. Use is made of a method proposed by Yarkova. (auth)

5801 (UUIP–777) CALCULATIONS ON THE ION-BEAM TRANSPORT SYSTEM OF THE TANDEM ACCELERATOR AT UPPSALA. Olsmats, M.; Wannberg, B. (Uppsala Univ. (Sweden). Inst. of Physics). Apr 1972. 14p. Dep. NTIS (U. S. Saless Only).

The ion-optical properties of the beam-handling system of the tandem Van de Graaff accelerator at Uppsala are studied. The purpose of the investigation is to ascertain the positions of the quadrupole magnets and experimental set-ups most appropriate for each experiment. The influence on the time-spread of a pulsed beam is analyzed. It is found that, in order to fully utilize the pulsing system of the accelerator, the beam must have a waist inside the analyzing magnet, necessitating direct stabilization of the accelerating voltage. (auth)

5802 SELF-CONSISTENT VLASOV DESCRIPTION OF RELATIVISTIC ELECTRON RING EQUILIBRIA. Davidson, R. C.; Lawson, J. D. (Univ. of Maryland, College Park). Particle Accel.; 4: No. 1, 1-18(Oct 1972).

The general procedure for constructing self-consistent relativistic ring equilibria within the framework of the steady-state ($\delta/\delta t = 0$) Vlasov–Maxwell equations is discussed. The equilibrium properties are calculated for the specific choice of electron distribution function $f_e^0(H,P_\theta)$ in which all of the electrons have the same value of total energy (H) and the same value of canonical angular momentum (P_θ), i.e., $f_e^0(H,P_\theta) = N_0\delta(H - \gamma_0 mc^2 + e\bar{\phi}_0)\,\delta(P - P_0)$, where N_0, γ_0, $\bar{\phi}_0$ and P_0 are constants. The positive ions are assumed to provide a partially neutralizing background with density $n_i^0(r,z) = n_e^0(r,z)$, where f = constant = fractional neutralization. For a thin ring, with $\nu/\gamma_0 \ll 1$ (ν = Budker's parameter, and $\gamma_0 mc^2$ = electron energy), it is shown that the electron density and current density are approximately constant in the ring interior, and that the envelope equation (the equation for the boundary of the minor cross section of the ring) is the equation for an ellipse, $p^2/a^2 + z^2/b^2 = 1$. Closed expressions are derived for a and b in terms of properties of the equilibrium distribution function and the external confining field, and the temperature profile transverse to the beam is also calculated. Moreover, for a thin ring with $\nu/\gamma_0 \ll 1$. It is shown that the equilibrium distribution function $f_e^0(H,P_\theta) = N_0\delta(H - \gamma_0 mc^2 + e\bar{\phi}_0)(P - P_0)$ represents the well-known microcanonical distribution discussed by Kapchinskij and Vladimirskij (Plasma Phys.; 5: 17(1963)), and Walsh (Proc. Int. Conf. on High Energy Instrumentation. CERN. Geneva, p. 274 (1959)). (auth)

5803 RELATIVISTIC ELECTRON RING EQUILIBRIUM WITH THERMAL ENERGY SPREAD. Davidson, R. C.; Mahajan, S. M. (Naval Research Lab., Washington, DC). Particle Accel.; 4: No. 1, 53-9(Oct 1972).

The steady-state ($\delta/\delta t = 0$) Vlasov–Maxwell equations are used to construct a self-consistent relativistic electron ring equilibrium which incorporates a thermal spread in energy of the electrons. The equilibrium properties of the ring are calculated for the specific choice of electron distribution function $f_e^0(H,P_\theta)$ in which all of the electrons have the same value of canonical angular momentum (P_θ) and a Gibbs distribution in total energy (H), i.e., $f_e^0(H,P_\theta) = N_0\delta(P - P_0)\exp[-(H - \gamma_0 mc^2 + e\bar{\phi}_0)/\oplus]$, where $N_0 P_0, \gamma_0 \bar{\phi}_0$, and $\oplus$ are constants. The positive ions are assumed to provide a partially neutralizing background with density $n_i^0(r,z) = fn_e^0(r,z)$, where f = const = fractional neutralization. For a thin ring, with $\nu/\gamma_0 \ll 1$ (ν = Budker's parameter, and $\gamma_0 mc^2$ = electron energy), it is shown that the electrons have a Gaussian density profile, $n_e^0(r,z) = n_0 \exp[-(r - R_0)^2/2a^2 - z^2/2b^2]$, where R_0 is the equilibrium radius of the ring. Closed expressions are derived for a and b in terms of properties of the equilibrium distribution function and the external confining field. The temperature profile transverse to the beam is shown to be isothermal with $T_\perp(r,z) = \oplus$. (auth)

5804 INTENSIVNYE ELEKTRONNYE I IONNYE PUCHKI. (Intense Electron and Ion Beams). Molokovskii, S. I.; Sushkov, A. D. Leningrad; Izdatel'stvo Energiya Leningradskoe Otdelenie (1972). 272p.

The apparatus and systems generally employed in forming and focusing intense electron and ion beams represent the chief subject matter on this monograph. Methods of calculating electrostatic and magnetic fields in electron-optic systems are considered. The motion of isolated charged particles in electric and magnetic fields and the motion of currents of charged particles, and the design of electrostatic and magnetic lenses are discussed. The last chapter is concerned with features of electron beams with plasma emitters, and the allied topics of plasma sources and gas discharge. (K.S.W.)

Storage Rings

5805 (BNL–17272) ISA CLOSED ORBIT DISTORTIONS AND CORRECTIONS. Crosbie, E. A.; Rowe, E. M. (Brookhaven National Lab., Upton, N. Y.). 30 Aug 1972. 5p. Dep. NTIS.

Some comments are presented on monitoring and correction of ISABELLE closed orbit distortions. (auth)

5806 (BNL–17273) VISUAL DETECTORS FOR ISA. Roe, B.; French, H. (Brookhaven National Lab., Upton, N. Y.). 12 Oct 1972. 5p. Dep. NTIS.

A proposal for an experimental facility for ISABELLE employing visual radiation detectors for studying high energy interactions is briefly described. It is proposed that the initial design of ISABELLE include an intersection region immersed in a large volume magnetic field in which the visual detectors can be placed. (W.H.K.)

5807 (BNL–17274) RF STACKING IN ISABELLE. Keil, E.; Sessler, A. M. (Brookhaven National Lab., Upton, N. Y.). 1972. 7p. Dep. NTIS.

A modified rf stacking scheme for ISABELLE is proposed. The 12 bunches circulating in the AGS are transferred into ISABELLE by a fast ejection–injection scheme. They are captured in rf buckets and accelerated in energy to a stacking orbit and deposited there with suppressed buckets, by nonadiabatically turning off the rf voltage. The process is repeated about 50 times resulting in 6×10^{14} protons stored in an energy spread of about 40 MeV. Subsequently, the coasting stack is bunched and accelerated by a system similar to that presently contemplated for ISA. (W.H.K.)

5808 (BNL–17275) MOMENTUM AND TIMING TOLERANCES FOR AGS–ISABELLE SINGLE-BUNCH TRANSFER SCHEME. Montague, B. W. (Brookhaven National Lab., Upton, N. Y.). 28 Sep 1972. 3p. Dep. NTIS.

In the proposed bunch-by-bunch transfer from the AGS to ISABELLE three longitudinal-type problems can be distinguished including 1) momentum error of a transferred bunch with respect to the ISABELLE rf bucket; 2) coarse timing of transfer, to inject the AGS bunch into the neighborhood of the correct ISABELLE bucket; and 3) final phasing of transfer, to place the AGS bunch close to the center of the bucket. The tolerances required with respect to these aspects are briefly discussed. (W.H.K.)

5809 (BNL–17314) WHAT NOT TO DO WITH ISABELLE AND WHY. Kreisler, M. N. (Massachusetts Univ., Amherst); Lee, Y. Y. (Brookhaven National Lab., Upton, N. Y.). 30 Oct 1972. 6p. Dep. NTIS.

The possibilities of μp interactions and single-beam whiplash to generate monoenergetic neutron beams at ISABELLE are examined. It is concluded that both cases are impractical. (auth)

5810 (FRNC-TH–251) TWO EXAMPLES OF NONLINEAR EFFECTS IN ELECTRON AND POSITRON STORAGE RINGS. Jejcic, Alain (Paris Univ., Orsay (France)). 1972. 88p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Third-order nonlinear resonances in the Orsay storage ring (ACO) were studied using a single stored beam; operating conditions were near or at the third-order resonance. It was shown that in this storage ring, according to the initial state of the particle, the amplitude may become sufficiently large for wall losses to occur in the vacuum chamber. Nonlinear effects appearing when two beams having transverse Gaussian densities interact were studied. The overall expression for the nonlinear force of the space charge was taken into consideration in order to define rigorously the distribution function of the betatron frequencies for various interaction geometries: front crossing, angular crossing, and the partial compensation of the charge space. Because of the complexity of the calculations, studies of the changes in amplitude when the frequency dispersion brings the particles up to dangerous resonances were only considered qualitatively. (France)

5811 (LA-DC–72-1094) STUDY TO ADAPT A WEAK FOCUSING SYNCHROTRON TO A STRONG FOCUSING PROTON STORAGE RING. Avery, R. T.; Garren, A. A.; Gunn, J. T. (California Univ., Berkeley. Lawrence Berkeley Lab.); Fullwood, R. R.; Lieber, A. J. (Los Alamos Scientific Lab., N. Mex.);

Meads, P. F. Jr. (Brobeck (William M.) and Associates, Berkeley, Calif.). [nd]. 7p. (CONF-720908–5). Dep. NTIS.

From fourth international conference on magnet technology; Upton, NY. (19 Sep 1972).

The high intensity of a storage ring makes it a powerful instrument for nuclear research by manipulating the beam duty factor from a machine such as the Los Alamos Physics Facility (LAMPF). Some of the proposed uses for an intense medium energy (800 MeV) proton storage ring are: (1) defense applications, (2) neutron pulse radiolysis, (3) duty stretcher for counting experiments, (4) pulsed source for an unstable particle storage ring, (5) study of beam dynamics, and (6) neutron time-of-flight spectrometer. The transition energy is placed above the particle energy to avoid the negative mass instability. In order to attain maximum current storage, protons would be injected by H^- stripping inside the ring and thereby avoid the Liouville constraint. This low-duty mode has the design objective of a 40 A circulating current. Another mode of operation, the high-duty mode, accepts 25 turns of proton injection by a combination of orbit and tune shifting; 120 times per second. Extensive lattice calculations were performed to implement these concepts. These resulted in the choice of a racetrack configuration which could employ the California Institute of Technology synchrotron magnets that were originally the $\frac{1}{4}$ scale Bevatron. These magnets would be fitted with new pole tips to form a strong focusing matrix with a π–2π matched insert in the long, straight sections. (auth)

5812 (SLAC-Trans-146) CALCULATION OF THE SHIELDING FOR THE STORAGE RING "DORIS." Dinter, H.; Tesch, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Translated for Stanford Linear Accelerator Center, Calif., from report DESY-D3/10. 23p. Dep. NTIS.

The shielding calculations for the storage ring DORIS are presented. The design philosophy is outlined, and it is shown how the beam power has to be limited for injection into the ring. The calculations are performed in a simplified manner: only 3 components are considered, the electromagnetic component, the giant-resonance neutrons and the high-energy neutrons above 25 MeV; the dose is calculated from experimentally determined source terms (for the first-mentioned component in 5 different geometries) and from attenuation factors also taken from experiments. The results are given for 5 typical locations and two cases: the loss of the injected beam (beam power 300 W) and the loss of the stored beam (6 A at 2 GeV). (auth)

Experimental Facilities

Refer also to abstracts 5363, 5806, and 6060.

5813 (LA–5092) COMPUTER CONTROL OF EPICS BEAM LINE AND SPECTROMETER. Egger, J. P.; Thiessen, H. A. (Los Alamos Scientific Lab., N. Mex.). Nov 1972. Contract W-7405-eng-36. 9p. Dep. NTIS.

Computer controls and checking of the LAMPF EPICS channel and spectrometer using the CAMAC system and a PDP-11/45 computer interfaced with a microprogrammed branch driver (MBD) are described. (auth)

5814 (LA-DC–72-1105) ALGORITHM FOR ELIMINATING THE DUODECAPOLE COMPONENT IN QUADRUPOLE MAGNETS. Hassenzahl, W. V. (Los Alamos Scientific Lab., N. Mex.). [nd]. 6p. (CONF-720908–8) Dep. NTIS.

From 4th international conference on magnet technology; Upton, NY. (19 Sep 1972).

The stringent field requirements of the beam lines at the Los Alamos Meson Physics Facility (LAMPF) restrict the n = 6, duodecapole component in quadrupoles to <0.1% in the integrated field. This has been achieved by the standard procedure of chamfering the poles. An algorithm has been developed which relates the chamfer required to reduce the integrated duodecapole component to three quantities: the bore radius, the iron length, and the central field duodecapole component. Since the central field value of n = 6 may be calculated from the pole contour and the coil geometry, the chamfer may be prescribed before fabrication. Equivalently, the algorithm may be used to choose a pole contour such that the central and fringe field duodecapole components cancel. (auth)

5815 (LA-DC–72-1106) RADIATION-HARDENED MAGNETS USING MINERAL-INSULATED CONDUCTORS. Harvey, A. (Los Alamos Scientific Lab., N. Mex.). [nd]. 13p. (CONF-720908–7). Dep. NTIS.

From 4th international conference on magnet technology; Upton, NY. (19 Sep 1972).

A unique feature of the LAMPF high-intensity linac experimental area is the extensive use of inorganic magnet coils to withstand the high radiation doses expected. The coil insulation is compacted magnesium oxide powder ("mineral insulation," m.i.) and preinsulated cable is wound into the required coil configuration. Although the cable itself is expensive compared to bare copper conductor, the finished coil cost is comparable to a conventional coil, since no insulation application is required of the coil winder. Two conductor formats are used at LAMPF: solid conductor, externally cooled, using soft solder to improve the heat transfer within the coil; and directly cooled, hollow conductor m.i. cable. At LAMPF both conductor types are conservatively rated. Indirectly cooled coils are used exclusively in the switchyard magnets, where low field strengths and high quality are required. Higher-power magnets for target-to-target transport and secondary beam lines use direct cooling. Methods of making terminations on the cable are described. Measured operating parameters for all these magnets are tabulated. Pole-shaping techniques for the bending magnets and quadrupoles are examined and the results given. (auth)

5816 (UCRL–74031) INTENSE SOURCES OF HIGH-ENERGY NEUTRONS. Barschall, H. H. (California Univ., Livermore. Lawrence Livermore Lab.). 14 Jul 1972. 13p. (CONF-720701–4). Dep. NTIS.

From International conference on nuclear structure study with neutrons; Budapest, Hungary (31 Jul 1972).

The status of new intense sources which produce neutrons above 10 MeV is reviewed. For radiation therapy adequate neutron intensities can be obtained with available cyclotrons using neutrons from Be(d,n). With low voltage accelerators the presently available source strength with d-T neutrons is about a factor of three below the desirable intensity, but several approaches for obtaining adequate intensity are being pursued, and one or several of these will undoubtedly be successful. For the application in materials testing for controlled thermonuclear reactions there is no source available that will duplicate the effects on materials in such a reactor. Only studies from which extrapolations can be made appear feasible with neutron sources available now or in the near future. At present the most intense source available is again a cyclotron that produces Be(d,n) neutrons although d-T sources of somewhat lower intensity are available and may have some advantages. (auth)

5817 INTERACTIVE BEAM DESIGN PROGRAM WITH MONTE CARLO CAPABILITIES. Amundson, D. V.; Dawson, J. W. (Argonne National Lab., IL). Particle Accel.; 4: No. 1, 19-30(Oct 1972).

The development of an interactive program for beam design is presented. The desirable features of an interactive program are discussed and the capabilities of this program are compared with programs for batch processing. The program, as implemented, provides Monte Carlo capability as well as ray tracing, optimization, and phase plane mapping, while accepting up to 333 elements. The program has been used in the design of a number of beams at Argonne. (auth)

5818 CRYOGENIC APPARATUS FOR NUCLEAR-TARGET ORIENTATION. Fasoli, U.; Galeazzi, G.; Toniolo, D.; Zago, G. (Istituto Nazionale di Fisica Nucleare, Padua). Lett. Nuovo Cim.; 5: No. 3, 209-12(16 Sep 1972).

The system embodies a ^3He refrigerator which cools down the target to temperatures less than 0.35°K and a solenoid superconducting magnet which produces magnetic fields of 40 kG. The system is intended primarily for studying the interaction of fast neutrons with oriented nuclei. A holmium bar 11.0 cm long and 1.8 cm in diameter will be the first target used. (W.H.K.)

5819 DEVELOPMENT OF AN EXPERIMENTAL DEVICE FOR STUDYING RADIATIVE CAPTURE REACTIONS INDUCED IN Li. Schaeffer, M.; Degre, A.; Suffert, M.; (and others) (Centre National de la Recherche Scientifique, Strasbourg). Rev. Phys. Appl.; 7: No. 2, 133-6(Jun 1972). (In French).

A device consisting of a lithium evaporator and a target wobbler is presented. The evaporator enables uncontaminated in situ targets to be prepared. The wobbler avoids overheating of the target by imposing a Lissajous type figure motion on it. (France)

5820 FOAM-INSULATED LIQUID HYDROGEN TARGET FOR STREAMER CHAMBERS. Watson, J. M.; Sevcik, V.; Peifer, J. (Argonne National Lab., IL). Nucl. Instrum. Methods; 105: No. 1, 33-6(1972).

The design and performance of a liquid hydrogen target used within the sensitive volume of a large streamer chamber are described. A polyvinylchloride foam was used for thermal and electrical insulation. None of the high-voltage problems of earlier designs was encountered. (1 figure) (auth)

5821 LIQUID GAS TARGET SYSTEM FOR MEDIUM ENERGY ELECTRON SCATTERING. Wendling, R. D.; Walther, V. H.; Averdung, H. (Univ., Mainz). Nucl. Instrum. Methods; 105: No. 1, 125-7(1972).

A liquefied-gas target system is described, which is suitable for high-resolution electron scattering experiments at medium energies. The liquid-gas chamber of the target system has, for ease of comparison with solid targets, the form of a thin-walled flat box 2 mm in thickness. The position of the target assembly can be changed by remote control. (4 figures) (auth)

5822 METHODS FOR CALCULATING THE EFFECTS OF ERRORS WHICH INCREASE THE BEAM SPOT SIZE AT THE END OF A BEAM TRANSPORT SYSTEM. Lobb, D. E. (Univ. of Victoria, B. C.). Nucl. Instrum. Methods; 105: No. 1, 129-40 (1972).

The following errors in a beam transport system are treated: bending magnet current fluctuations, quadrupole current fluctuations, rotations of quadrupoles about the quadrupole axis, rotations of bending magnets about the incoming central trajectory, and higher harmonic error fields in quadrupole lenses. Numerical values are presented for a representative system. (2 figures, 3 tables) (auth)

5823 FOCUSING SYSTEM FOR NEUTRINO EXPERIMENTS. Danilchenko, I. A.; Rzaev, R. A.; Samoylov, A. V.; Voronov, V. I. (Inst. for High Energy Physics, Serpukhov, USSR). Nucl. Instrum. Methods; 105: No. 1, 147-55(1972).

A magnetic-optic system, consisting of linear-focusing units, is studied. As the result of the analysis an optimum system, consisting of parabolic lenses, is chosen. The system may be used for the IHEP neutrino experiments. The calculated ratio and neutrino spectra are presented. (10 figures, 2 tables) (auth)

5824 DESIGN OF A MAGNETIZED IRON MUON SHIELD FOR A HIGH ENERGY NEUTRINO LABORATORY. Kang, Y.; Lee, K.; Roberts, A.; (and others) (National Accelerator Lab., Batavia, IL). Particle Accel.; 4: No. 1, 31-41(Oct 1972).

Several new ideas are adduced to the problem of designing muon shielding for a neutrino experimental facility operated at high energy, a problem of interest for the National Accelerator Laboratory (NAL) and CERN-II. A practical calculational procedure is outlined which permits the evaluation of the effect of magnetized-iron-lens geometries on the intensity distribution of muons at the detector location. Such relevant effects as range straggling and multiple scattering within and around the lens are included in the evaluation. A specific design is outlined which would increase the maximum energy of bubble chamber beams in the NAL neutrino area from 350 to about 500 GeV. (auth)

5825 ZING: AN INTENSE NEUTRON GENERATOR BASED ON THE ZGS INJECTOR-BOOSTER ACCELERATOR. Carpenter, J. M. (Univ. of Michigan, Ann Arbor). Trans. Amer. Nucl. Soc.; 15: No. 2, 906-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5826 POTENTIAL EDNA PERFORMANCE CHARACTERISTICS. Coats, R. L. (Sandia Labs., Albuquerque, N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 908(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

5827 PULSED SOURCES OF FAST NEUTRONS. Bobrowski, Czeslaw; Chrusciel, Edward; Massalski, Jerzy. Zesz. Nauk. Akad. Gorn.-Hutn., Cracow, No. 208, Mat., Fiz., Chem.; No. 2, 155-64(1969). (In Polish).

Prototypes of portable neutron generators applicable for laboratory work as well as for borehole measurements, designed in the Institute of Nuclear Techniques, are described. The devices contain an original type of neutron tube in which the reaction T(d,n) as a source of fast neutrons has been used. The yield of neutrons during permanent operation of the portable generator is about 10^8 n/s. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 6043–6045, 6048–6051, 6053, 6054, 6056–6059, 6063–6066, 6073–6078, 6083–6088, 6182, 6183, and 6467.

5828 COSMIC RAY STUDIES FROM LUNAR SAMPLES. Bhandari, N.; Goswami, J. N. (Tata Inst. of Fundamental Research, Bombay). Nucl. India; 10: No. 7, 3-5(Mar 1972).

In the past few years, lunar samples have proved to be of great interest as space probes and have revealed a great deal of information about cosmic rays, their time variations, modulation, and composition. Unlike the terrestrial rocks which are exposed only to secondary cosmic rays because of the dense atmosphere, lunar surface soil and rocks show records of primary cosmic rays in abundance. Effects of the implanation of solar-wind ions, the radioactivity produced by protons and alpha particles, and the solid state damage due to heavy cosmic-ray nuclei ($Z > 20$) have been investigated in these samples. Since the lunar grains contain records of a wide variety, selective techniques like etching, plastic replication, and high-resolution optical measurements have been evolved. From an analysis of nearly a dozen rock samples, an average energy spectrum of the iron group nuclei up to energies of 5 BeV/N has been obtained. The lunar rocks are found to be specially suited to study solar cosmic rays produced during solar flares, since this component dominates the galactic component at low energies and the damage due to solar cosmic rays is so intense that good resolution of the fossil tracks can be obtained only through electron microscopy. The effects are stored and long cores taken from lunar surface soil have proved to be specially valuable in studying cosmic-ray records for millions of years in the past. This fact makes a comparison between contemporary and pre-historic cosmic rays possible and also opens up the possibility of studying the activity in the Sun in the remote past as a function of time. (INIS)

5829 ANISOTROPY AND DIFFUSION OF COSMIC-RAY ELECTRONS. Mao, C. Y.; Shen, C. S. (National Tsing Hua Univ., Hsinchu, Taiwan). Chin. J. Phys. (Taiwan); 10: No. 1, 16-28(Apr 1972).

Anisotropy of cosmic-ray electrons caused by the streaming motion of particles from nearby sources is estimated. Comparison with the anisotropy caused by synchrotron radiation shows the former giving a dominant contribution to the electron anisotropy, which rises to ≥ 0.1 at energies greater than 100 GeV. The maximum intensity is expected to be in the direction of Vela pulsar. (auth)

5830 DEPENDENCE OF SCINTILLATION COUNTING RATE OF COSMIC-RAY AIR SHOWERS AT SEA LEVEL ON SCINTILLATOR AREA. De, A. K.; Ghosh, P.; Mitra, S.; (and others) (University Coll. of Science, Calcutta). Indian J. Pure Appl. Phys.; 10: No. 4, 326-8(Apr 1972).

The dependence of scintillation counting rates on the scintillator area when exposed to the extensive air showers (EAS) of cosmic rays is discussed and a theoretical relation for the integral number spectrum is deduced. Experimental results obtained with the plastic scintillators of three different areas are found to be in good agreement with the theoretical predictions. The exponent of the EAS density spectrum determined from experimental data also agrees with the values reported earlier. (auth)

5831 ANTIMATTER AND BALL LIGHTNING. Crawford, J. F. (Stanford Univ., Calif.). Nature (London); 239: No. 5372, 395(13 Oct 1972).

Evidence has been published of the observation of photon fluxes lasting ≤ 1 sec at an energy corresponding to positron annihilation, in connection with the possibility that "ball lightning" may be associated with the existence in the terrestrial environment of small quantities of antimatter, and here evidence is presented that fluxes of this type can be expected from extensive air showers caused by primary cosmic rays of energy $E_0 \sim 10^{16}$ eV. The arguments advanced are not precise, but they indicate that substantial fluxes of 511-keV photons can be expected in the cores of extensive air showers. Apart from any relevance to "ball lightning" these findings may be of use in cosmic-ray studies. (UK)

5832 METEOROLOGICHESKIE EFFEKTY KOSMICHESKIKH LUCHEI. (Meteorological Effects of Cosmic Rays). Dorman, L. I. Moscow; Izdatel'stvo Nauka (1972). 212p.

This monograph describes the meteorological effects of the muon, electron-photon, neutron, and other components of cosmic radiation. The theory of such meteorological effects has been sufficiently refined in recent years to include a consideration of the meson–nucleus cascade in the Earth's atmosphere. The methods used to determine the meteorological parameters in the upper strata of the atmosphere are summarized. Barometric and temperature effects are examined in detail, and the theory of cosmic-ray variations of atmospheric origin is fully treated. 337 references. (K.S.W.)

5833 ENERGETIC NEUTRONS LEAKING FROM THE TOP OF THE ATMOSPHERE. Merker, Milton (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett.; 29: No. 22, 1531-4 (27 Nov 1972).

The energy, angular, and latitude distributions of energetic neutrons (up to 2 GeV) leaking from the top of the atmosphere were calculated. The results agreed with the recent measurement of Preszler, Simnett, and White, whose leakage rates were well above the calculation of Lingenfelter. Since the spectrum of Lingenfelter has served for evaluating the cosmic-ray albedo-neutron decay (CRAND) source of energetic protons in Earth's inner radiation belt, it is suggested that the results reported be used to reevaluate the CRAND contribution. (auth)

5834 INFLUENCE OF SINGLE SCATTERING PROCESS ON THE HORIZONTAL FLUXES OF COSMIC MUONS IN WATER. Matachun, A. T.; Trubkin, Yu. A.; Fedorov, V. M. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 16: No. 2, 343-8(Aug 1972). (In Russian).

The flux of cosmic rays at angles close to horizontal and their energy spectra at depths of 500, 1000, 2000m below water were calculated taking into account single scattering processes in the vicinity of the detecting device. It is shown, that in spite of a comparatively soft nature of scattered muon spectra, one should take them into account when analyzing measurement results in the devices with a relatively low-energy threshold for the particles being detected. (auth)

5835 DIFFUSION OF COSMIC RAYS AND THEIR SOURCE COMPOSITION. Shapiro, M. M.; Silberberg, R.; Tsao, C. H. (Naval Research Lab., Washington, D. C.). pp 124-49 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

Topics considered include path lengths of cosmic rays, distribution of path lengths, diffusion equations (transformations in space), calculations, and cosmic-ray versus solar composition. (W.D.M.)

5836 COSMIC RADIATION AS A SOURCE OF ODD NITROGEN IN THE STRATOSPHERE. Warneck, Peter (Max-Planck-Institut fuer Chemie, Mainz). J. Geophys. Res.; 77: No. 33, 6589-91(20 Nov 1972).

The effect of cosmic radiation on odd nitrogen production in the stratosphere is investigated, and odd nitrogen mixing ratios are desired for selected conditions. (auth)

Stars

5837 I SCORPII AND NGC 6231. Milone, Luis A. (National Univ., Cordoba, Argentina). Bol. Inst. Mat., Astron. Fis.; 3: No. 2, 25-34(1968).

For I Scorpii a distance of 1800 pcs ± 80 pcs was found. The absolute magnitudes of an Of and two WR stars were −7.0 and −3.4, respectively. ζ_1 Sco seems to be one of the brightest stars in the Milky Way with an absolute magnitude of around −9. For the ratio $A_V/(A_B - A_V) = R$ the discussion points to a value of 3, or a somewhat smaller one. The stars selected to see if they satisfy the reddening law $E_{UB}/E_{BV} = +0.72 + 0.05\,E_{BV}$ depart from it by a small but systematic amount. For this association an age of around 10^6 years was found. (auth)

5838 HE I λ5876 LINE IN O-STAR SPECTRA. Anderson, C. M. (Univ. of Wisconsin, Madison). Astrophys. J.; 177: No.3, L121-4(1 Nov 1972).

New data are presented which resolve one of the more serious discrepancies between the theory and observations of O-star spectra. (auth)

5839 FORMATION OF PROTOSTARS BY THERMAL INSTABILITY. Stein, R. F. (Brandeis Univ., Waltham, Mass.); McCray, Richard; Schwarz, Joseph. Astrophys. J.; 177: No. 3, L125-8(1 Nov 1972).

Spherically symmetric condensations driven by thermal instabilities in a cooling interstellar medium can produce gravitationally bound clouds, provided that the magnetic field has been previously removed from the gas. The resulting clouds have a

very small (~10^{-4} pc), high-density (~10^{12} cm^{-3}), warm (~100°K), stationary core, surrounded by a large (~1 pc), cool (~10°K), infalling envelope. Their structure resembles that of an early stage in the protostar evolution calculated by Larson. Such objects may represent Bok globules. (auth)

5840 IONIZATION ENERGIES OF HYDROGEN IN MAGNETIC WHITE DWARFS. Rajagopal. A. K.; Chanmugam, G.; O'Connell, R. F.; Surmelian, G. L. (Louisiana State Univ., Baton Rouge). Astrophys. J.; 177: No. 3, 713-18(1 Nov 1972).

The variational principle is used to determine the ionization energy of a hydrogen atom in its ground state, in the presence of magnetic fields of the order of those found in magnetic white dwarfs and some neutron stars. The results are shown to be better than those obtained by using perturbation theory for all fields and significantly better than those of Cohen et al., for fields less than ~3×10^{10} gauss. A general procedure for obtaining the energies of higher levels is outlined. (auth)

5841 SYNTHETIC SPECTRUM OF THE CN RED SYSTEM AND ITS APPLICATION TO STELLAR SPECTRA OF MODERATE RESOLUTION. Marenin, Irene; Greene, A. E. (Ohio State Univ., Columbus). Astrophys. J.; 177: No. 3, 841-6(1 Nov 1972).

Assuming a Milne–Eddington model atmosphere, synthetic spectra were calculated for the CN red system from λ5600 to λ6800. The spectra were calculated for a pure $^{12}C^{14}N$ spectrum and a CN spectrum with a $^{12}C/^{13}C = 4$. They were then compared to the spectra of several S, SC, and C stars. Several conclusions can be drawn: (1) CN features are observed at all wavelengths with no obvious window. (2) The CN features are weakest between λλ6100 and 6120 and longward of λ6810. (3) The addition of $^{13}C^{14}N$ smoothes out the spectrum so that all bands are not very pronounced. (4) CN causes major problems in detecting traces of ZrO and C_2 in the red spectral region. (5) CN should be accounted for in any analysis of atomic lines in this region. (auth)

5842 STABILITY OF AXISYMMETRIC SYSTEMS TO AXISYMMETRIC PERTURBATIONS IN GENERAL REALTIVITY. III. VACUUM METRICS AND CARTER'S THEOREM. Chandrasekhar, S.; Friedman, J. L. (Oxford Univ.). Astrophys. J.; 177: No. 3, 745-56(1 Nov 1972).

The analysis of Paper II is specialized to vacuum metrics appropriately for a discussion of their stability. And Carter's theorem, that asymptotically flat axisymmetric vacuum metrices, external to black holes, cannot allow nontrivial axisymmetric neutral deformations, is deduced. (auth)

5843 MASSES AND RADII OF WHITE DWARFS. Shipman, H. L. (California Inst. of Tech., Pasadena). Astrophys. J.; 177: No. 3, 723-43(1 Nov 1972).

Additional model atmospheres representing the surface layers of hydrogen-rich and helium-rich white dwarfs were calculated and are presented in tables. These model atmospheres and multichannel photoelectric scans by Oke were used to determine the masses of 19 and the radii of 26 stars in Oke's observing program. The median radius of the program stars, which are in general among the intrinsically brightest white dwarfs, is 0.013 $R_\odot$, and the median mass is 0.52 $M_\odot$. The DA stars have effective temperatures between 6000° and 50,000°K, with N(He) < 0.008 by number. The DB stars have $12{,}000° \leq T_{eff} \leq 18{,}000°K$, and calcium abundances $\lesssim$0.01 of the solar value. The program stars were then used to calibrate a U − V versus T_{eff} relation, and radii were determined for all white dwarfs with known distances. The median radius of this sample of stars, which contains more intrinsically faint stars than the set of program stars, was 0.0095 $R_\odot$. The masses of some of these stars were found from surface gravities derived from the m_1-indices of Graham. The masses and radii found were in satisfactory agreement with the mass–radius relation for degenerate stars and with measured gravitational redshifts. The analyses were applied for the purpose of testing the convection-accretion hypothesis of Strittmatter and Wickramasinghe, which purports to explain the existence of the DB stars. The present results contradict their prediction that there should be a shortage of DA stars with effective temperatures between 15,000° and 18,000°K. A modification of their hypothesis is proposed which explains the existence of DB and DC stars in the observed temperature ranges. (auth)

5844 POLARIZED RADIATION FROM MAGNETIC WHITE DWARFS. II. SOLUTION OF KEMP'S MODEL AT ALL TEMPERATURES. Chanmugam, G.; O'Connell, R. F.; Rajagopal, A. K. (Louisiana State Univ., Baton Rouge). Astrophys. J.; 177: No. 3, 719-22(1 Nov 1972).

An exact solution of Kemp's model for polarized radiation from magnetic white dwarfs at low temperatures is extended to all temperatures. The implications of the results are discussed. (auth)

5845 STEADY ACCRETION IN THE PRESENCE OF ROTATION AND A MAGNETIC FIELD. Chia, T. T.; Henriksen, R. N. (Queen's Univ., Kingston, Ont.). Astrophys. J.; 177: No. 3, 699-711(1 Nov 1972).

The solution for steady accretion with the stream lines antiparallel to the magnetic field lines onto a rotating, nontranslating, gravitating, magnetic monopole is given. The flow is everywhere "sub-Alvénic," and the angular momentum flux can be outward despite the accretion. It is shown that because of the "tension" along the distorted magnetic field lines the accretion rate per unit solid angle can be greater than the corresponding "Bondi" value for the same conditions at infinity (i.e., in the accreted cloud). However, for this to be so, a definite value is required for the magnetic flux, and this quantity is also given. The flow can be conveniently referred to as an accretion vortex. The solution is particularly simple in the limit that thermal pressure may be neglected (being free of critical points) and should allow ready estimates in various strong field situations. A numerical illustration of the general case is presented. (auth)

5846 SEMICONVECTION. Mitalas, R. (Univ. of Western Ontario, London). Astrophys. J.; 177: No. 3, 693-7(1 Nov 1972).

A condition for the occurrence of semiconvection is derived for a general opacity law. It is shown that a semiconvective zone is always initiated by the appearance of a convective zone in a region of varying mean molecular weight. The possibility of semiconvection during thermal helium flashes is suggested. (auth)

5847 METAL-POOR STARS. IV. THE EVOLUTION OF RED GIANTS. Rood, R. T. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 177: No. 3, 681-91(1 Nov 1972).

Evolutionary tracks have been obtained for Population II red giants for the following sets of (M,X,Z): (0.80 $M_\odot$, 0.7, 10^{-4}), (0.80 $M_\odot$, 0.7, 10^{-3}), (0.80 $M_\odot$, 0.8, 10^{-3}), (0.60 $M_\odot$, 0.7, 10^{-3}), and (0.80 $M_\odot$, 0.7, 10^{-2}). The mass of the helium core at the flash is found to be $M_c/M_\odot = 0.475 + 0.23\,(X - 0.7) - 0.01\,(\log Z + 3) - 0.035\,(M/M_\odot - 0.8)$. If direct electron–neutrino interactions are neglected, the core masses are 0.033 $M_\odot$ larger. The lifetimes on the giant branch above a given luminosity are also determined. These are somewhat lower than in earlier work. Small bumps are predicted in red-giant luminosity functions. (auth)

5848 LUMINOSITIES OF LATE-TYPE STARS OF DIFFERING METAL ABUNDANCE. Jones, D. H. P.; Dixon, M. E. (Australian National Univ., Canberra). Astrophys. J.; 177: No. 3, 665-80(1 Nov 1972).

A technique is described which determines approximate luminosities of G- and K-type stars. It is based on narrow-band photometric observations of the Mg b-lines and the blue CN band, and upon broad-band observations of ultraviolet excess, δ(0.6), and the blanketing-free index, $(B - V)_c$. The technique may be applied to stars of normal as well as of low metal abundance, but special attention is given to stars of low metal abundance. The use of the technique in kinematic studies is illustrated by reference to stars in Sandage's list of newly discovered subdwarfs. (auth)

5849 STELLAR ATMOSPHERES WITH RADIATION INCIDENT AT THE SURFACE. Buerger, P. F. (Ohio State Univ., Columbus). Astrophys. J.; 177: No. 3, 657-63(1 Nov 1972).

The usual surface boundary condition used in model stellar atmospheres is modified to allow for a plane-parallel beam of radiation incident at the surface. This involves a modification of the equation of a radiative transfer and a consequent modification of the temperature-correction scheme. Models have been computed in order to show the effects of the incident radiation on the resultant emergent radiation. Relatively small amounts of incident radiation can significantly affect the formation of the hydrogen lines. Applications to the analysis of eclipsing binaries are discussed. (auth)

5850 SOME CHARACTERISTICS OF THE MODERATELY OLD OPEN CLUSTER NGC 752. Garrison, R. F. (Univ. of Toronto). Astrophys. J.; 177: No. 3, 653-6(1 Nov 1972).

MK classifications are presented for 35 of the F-type stars in the cluster NGC 752. One star, Heinemann 193, has spectral peculiarities similar to those in some δ Scuti stars. Differential comparisons of line strength between NGC 752 and the Hyades are described, and a rediscussion of previous photometric results is presented. No convincing evidence is found, from either the photometry or the classifications, for line weakening. (auth)

5851 LUMINOSITY FUNCTIONS OF GIANT STARS IN GLOBULAR CLUSTERS. Bahcall, J. N.; Yahil, Amos (Inst. for Advanced Study, Princeton, N. J.). Astrophys. J.; 177: No. 3, 647-51(1 Nov 1972).

The observed luminosity function for stars on the giant branch of M15, as determined by Sandage, Katem, and Kristian, is compared with simulated luminosity functions generated from a smooth curve. Apparent features are seen in both the observed and simulated luminosity functions. A crude fit to the observed differential luminosity function is given by $N(L) \propto L^{-2.4}$. (auth)

5852 APPLICATION OF THE GENERALIZED NEWTON–RAPHSON METHOD TO THE SINGLY-IONIZED CALCIUM LINE FORMATION PROBLEM IN MODEL STELLAR ATMOSPHERES. Domenico, Benedict Albert. Boulder, Colo.; Univ. of Colorado (1972). 113p. University Microfilms Order No. 72-25,159.

Thesis.

A new method is proposed for solving the statistical equilibrium and radiative transfer equations for the level populations of a multilevel model atom in a model stellar atmosphere. These two sets of equations are reduced to a single system of nonlinear operator equations by incorporating the integral form of the radiative transfer equations into the equations of statistical equilibrium. An iterative procedure for solving this system, based on the Generalized Newton–Raphson (GNR) method, is described and compared to other methods currently being used to solve such problems. The GNR method eliminates the possibility of convergence to inconsistent solutions; and, in certain test cases, reduces the number of iterations necessary to reach convergence by as much as an order of magnitude. The GNR method is applied to the singly-ionized calcium line formation problem in an attempt to determine the types of atmospheres which give rise to the H and K fluxes observed by O. C. Wilson (Astrophysical Journal, 153, 221, 1968) in solar-type stars on the main sequence. Wilson's observations show that, as the strength of the emission features in the cores of these lines increases, the ratio of the K flux to the H flux also increases. The theoretical fluxes calculated for several model atmospheres indicate that the strength of the H and K line emission features is very sensitive to the temperature gradient above the temperature minimum region in the model atmosphere, while the flux ratio depends critically on the assumed microturbulent velocity in and above the temperature minimum region. (Diss. Abstr. Int., B)

5853 COLLAPSE OF A HOT HELIUM STAR. Guseinov, O. Kh. Soobshch. Shemakhinskoi Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 6, 3-8(1971). (In Russian).

The enormous neutrino energy liberated during the catastrophic compression of an extremely hot substance was investigated in the case of the collapse of a helium star. Photo-splitting and neutron interaction with nuclei were not considered. Assuming that the electron gas is completely degenerate, the starting point selected for the argument was an equation for the entropy of unit mass of the star (Landau and Livshits, 1964). Subsequent development showed that the temperature of a star may reach 2 to 6×10^{11}°K, and a neutrino may have an energy of 100 MeV. (K.S.W.)

5854 SEPARATION AND PULSATIONS OF A PREVIOUSLY COMPRESSED HIGH-DENSITY CONFIGURATION. Gurovich, V. Ts.; Guseinov, O. Kh. Soobshch. Shemakhinskoi Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 6, 17-24(1971). (In Russian).

Equilibrium high-density states apparently are nonexistent for masses $M > 1.6$ to $2M_\odot$. Gravitational forces may prevail over forces of pressure, and a gas will be compressed with a velocity approximating free fall, which for $r \rightarrow r_g$ tends toward the velocity of light. The period of adiabatic pulsations, density profiles, and rarefaction states are factors which were considered in the mathematical development. (K.S.W.)

5855 PROPERTIES OF THE SPECTRUM OF U MONOCEROS (UNICORN). Aliev, A. A. Soobshch. Shemakhinskoi Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 6, 59-68(1971). (In Russian).

The behavior of some spectral lines in the atmosphere of U Mon was examined. The appearance of emission lines (48 of which are tabulated) was probably caused by shock waves passing through its atmosphere. Changes in the contour of the lines H_α, H_γ, and H_δ were studied as functions of the phase of brightness of the star. (K.S.W.)

5856 NEUTRON STARS AND PULSARS. FERMI LECTURES 1970. Dyson, F. J. Quaderno N. 152. Rome; Accademia Nazionale dei Lincei (1971). 93p.

Seven lectures were presented covering the topics: historical background; dynamics of pulsar formation; slowing down of pulsars; structure of neutron stars (perfect-gas and realistic models); star-quakes and volcanoes on neutron stars; and the usefulness of pulsars as probes of galactic structure. (W.D.M.)

5857 ANALYTIC FORMS OF THE THERMONUCLEAR FUNCTION. Critchfield, C. L. (Los Alamos Scientific Lab., N. Mex.). pp 186-91 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

An early application of the theory of potential barrier penetration developed independently by Gamov and by Condon and Gurney was to the problem of energy generation in stars. An analytical approximation to the thermonuclear reaction rate formula in which the Gamov barrier plays such a central role is presented. (auth)

5858 INSIDE NEUTRON STARS. Pines, D. (NORDITA, Copenhagen). pp 7-17 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Following a review of the properties of the states of matter within neutron stars, the extent to which these may be inferred from direct observation of pulsar behavior is discussed. The sudden increases in pulse frequency, which have been observed for the Vela and Crab pulsars, and which may be produced by sudden disturbances in the stellar crust (starquakes), are shown to provide a probe of the liquid interior. Present evidence, which points to neutron and proton superfluidity in both pulsars, is summarized. (auth)

5859 SPECTROSCOPIC OBSERVATIONS OF HZ HERCULIS. Bopp, B. W.; Grupsmith, G.; Vanden Bout, P. (Univ. of Texas, Austin). Astrophys. J.; 178: No. 1, L5-8(15 Nov 1972).

Spectra were obtained of HZ Her, the optical counterpart of the pulsating x-ray source Her X-1 (= 2U 1705 + 34), which showed variable Ca II K absorption, λλ4640–4650 and λ4686 emission, and He I absorption lines. The emission lines varied on a timescale as short as 30m. The Ca II and the He I features indicated a composite spectrum combining A- and B-star characteristics. (auth)

5860 PERIOD AND LIGHT CURVE OF HZ HERCULIS. Bahcall, J. N. (Inst. for Advanced Study, Princeton, NJ); Bahcall, N. A. Astrophys. J.; 178: No. 1, L1-4(15 Nov 1972).

It is shown that HZ Herculis has an eclipse period and phase equal to the eclipse period and phase of the pulsating x-ray source Hercules X-1. Data for HZ Herculis are also given for the light curve, colors, proper motion, and the influence of the 35-day x-ray cycle on the optical light. A model for the binary system is described and the optical light curve is calculated. (auth)

5861 URANIUM IN THE SPECTRUM OF HR 465. Cowley, C. R.; Hartoog, M. R. (Univ. of Michigan, Ann Arbor). Astrophys. J.; 178: No. 1, L9-10(15 Nov 1972).

Uranium has been identified in the 1960–1961 spectrum of HR 465 at a confidence level of 3.8 σ (one chance in 10^4 of fortuitous occurrence). The uranium abundance is about a million times the solar-system value. This should be compared to the abundances of the lanthanides, for which Aller finds excesses $\leq 10^5$. (auth)

5862 DISCOVERY OF CIRCULAR POLARIZATION IN THE RED DEGENERATE STAR G99–47. Angel, J. R. P. (Columbia Univ., New York); Landstreet, J. D. Astrophys. J.; 178: No. 1, L21-2(15 Nov 1972).

Circular polarization is found in the light of the cool DC white dwarf G99–47 = GR 289, varying from 0.45% in the ultraviolet to 0.30% in the near-infrared. No evidence for time variability of the polarization is found. (auth)

5863 IMPORTANCE OF HIGH TIME RESOLUTION IN FLARE STAR OBSERVATIONS. Moffett, T. J. (Univ. of Texas, Austin). Nature (London) Phys. Sci.; 240: No. 98, 41-3(13 Nov 1972).

Reference is made to photoelectric observations of UV Ceti type flare stars. Typical flare phenomena reported show a rapid rise in brightness followed by a quasi-exponential decay. The experimental work was done with at best a time resolution of several seconds, and smooth flare curves have been published connecting a few observational points. Flare star observations are reported of a large number of events on UV Ceti type stars using time resolution as short as 50 ms, most of these being made with the 82 inch Struve reflector at the McDonald Observatory. It was evident that time resolution of several seconds fails to detect many features of the activity of flares, some of which have total lives of no more than two or three seconds, and is incapable of

recording details of some of the more rapid light fluctuations on the rising parts of the flare light curve, where rates of change of 20 magnitudes per minute can occur. In order to understand the physics of flare events the flares must be completely time resolved, and this requires high-speed observations with resolutions of a second or less. Conclusions resulting from the high-speed observations described are given, and observations are made on flare mechanisms. (UK)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 5859 and 5950.

5864 USE OF PULSAR SIGNALS AS CLOCKS. Reichley, P.; Downs, G.; Morris, G. JPL Quart. Tech. Rev.; 1: No. 2, 80-6(Jul 1971).

The pulses of energy from pulsars are regarded as ticks from a clock. By comparing this pulsar clock with an Earth-based atomic clock, several variations in the pulsar clock's frequency are noted. The major effect is due to the motion of the atomic clock in relation to the pulsar clock and contains information on the pulsar's position, elements of the Earth's orbit, and solar relativistic effects. Another effect is the slowly varying frequency of the pulsar clock and contains information on the physics of the pulsar. In this article, the measurements of these effects and their present and future applications are discussed. (auth)

5865 IDENTIFICATION OF THE X-RAY PULSAR IN HERCULES: A NEW OPTICAL PULSAR. Davidsen, Arthur; Henry, J. P.; Middleditch, John; Smith, H. E. (Univ. of California, Berkeley). Astrophys. J.; 177: No. 3, L97-102(1 Nov 1972).

A series of photographic, photoelectric, and spectroscopic observations beginning June 1, 1972 has led to the optical identification of Her X-1 (2U 1705 + 34), a pulsed x-ray source in an eclipsing binary system, with the thirteenth-magnitude blue variable star HZ Herculis. The detection of optical pulses at the frequency of the x-ray pulsar on three nights makes the identification conclusive and establishes HZ Her as the second known optical pulsar. The strength of the optical pulses may be correlated with the orbital phase but is not obviously related to the high- or low-intensity states of the x-ray source. (auth)

5866 OPTICAL STUDIES OF UHURU SOURCES. III. OPTICAL VARIATIONS OF THE X-RAY ECLIPSING SYSTEM HZ HERCULIS. Forman, William; Jones, C. A.; Liller, William (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. J.; 177: No. 3, L103-7(1 Nov 1972).

Photographic observations reveal several unusual properties of the x-ray eclipsing system HZ Herculis and suggest that the source of x rays lies on the surface of a rapidly rotating collapsed object which revolves about an A- or F-type subgiant. The resultant tidal distortions and reflection–excitation effects of the collapsed object on the subgiant appear to explain satisfactorily the optical observations. (auth)

5867 MEASUREMENT OF THE POSITION AND SPECTRUM OF HERCULES X-1 FROM THE OSO-7 SATELLITE. Clark, G. W.; Bradt, H. V.; Lewin, W. H. G.; (and others) (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 177: No. 3, L109-13(1 Nov 1972).

In December, 1971 the periodically variable binary x-ray source Her X-1 was scanned twice by the 1 to 60-keV x-ray detectors on the OSO-7. The observations were made during uneclipsed times when the source was in the high intensity phase of its 36-day period. The source position was measured to be within an error circle of 0.3° radius centered on α = 16 h 56.6m, δ = 35°32′ (1950.0). The average spectrum is markedly harder than that of Tau X-1, and is consistent with either a power law with spectral index 0.50 ± 0.15 or an exponential law with kT = 60 ± 20 keV. (auth)

5868 SEARCH FOR INTERSTELLAR ^{14}CO. Schwartz, P. R. (Naval Research Lab., Washington, D. C.); Wilson, W. J. Astrophys. J.; 177: No. 3, L129-30(1 Nov 1972).

A search for interstellar ^{14}CO was made at 105 871.11 MHz in seven galactic ^{12}CO sources with negative results. (auth)

5869 MORE UNUSUAL RADIO EVENTS IN CYGNUS X-3. Hjellming, R. M.; Balick, B. (National Radio Astronomy Observatory, Green Bank, WV). Nature (London) Phys. Sci.; 239: No. 95, 135-6(23 Oct 1972).

Observations of additional outbursts in Cyg X-3 following the September 1972 large outburst are reported, using the National Radio Astronomy Observatory interferometer. On one occasion the source suddenly increased its flux by two orders of magnitude at both 2695 and 8085 MHz. Data are shown plotted for flux density and spectral index. Other major outbursts were also observed, including three during a four week period. In one the spectral index decreased smoothly at the beginning of the flare, reaching a value of zero near the time of flare maximum at both frequencies. Another outburst was remarkably dissimilar because of its longer duration and its relatively steady spectral index; it seems likely that reinjection of relativistic electrons occurred repeatedly during this outburst and that the electron energy distribution attained a quasi-equilibrium state. The outbursts that have been observed clearly indicate that sporadic injection of relativistic electrons has dominated the characteristics of the synchrotron radio emission of the major events. (UK)

5870 X-RAY OBSERVATIONS OF CYGNUS X-3 BY COPERNICUS. Sandford, P. W.; Hawkins, F. H. (Mullard Space Science Lab., Dorking, Eng.). Nature (London) Phys. Sci.; 239: No. 95, 135(23 Oct 1972).

Cygnus X-3 was observed with the x-ray instrument on the fourth Orbiting Astronomical Observatory (Copernicus) for three periods during the recent radio enhancement. Two features were apparent in the data. There was clear evidence of a regular drop in x-ray intensity by a factor of 2, and there were also other significant variations in intensity, although not as marked as the regular drop. (UK)

5871 SEARCH FOR A VISIBLE COUNTERPART OF THE SEPTEMBER 2, 1972 RADIO OUTBURST IN CYGNUS. Westphal, J. A.; Kristian, J.; Huchra, J. P.; Shectman, S. A.; Brucato, R. J. (Carnegie Institution of Washington, DC). Nature (London) Phys. Sci.; 239: No. 95, 134-5(23 Oct 1972).

Attempts were made to detect a visible object at the radio position at several wavelengths from the blue to the near infrared, using direct photographs taken with the Palomar 48 in. Schmidt camera and measurements made at the prime focus of the 200 in. telescope with a new integrating two-dimensional Si vidicon photometer. No visible object was detected at the radio position in any of the data. (UK)

5872 OBSERVATIONS OF CYGNUS X-3 AT THE MULLARD RADIO ASTRONOMY OBSERVATORY. Branson, N. J. B. A.; Martin, A. H. M.; Pooley, G. G.; (and others) (Cambridge Univ., Eng.). Nature (London) Phys. Sci.; 239: No. 95, 133-4(23 Oct 1972).

Observations of radio outbursts of Cygnus X-3 were made at several frequencies since the time of its large outburst in September 1972. Flux density variations were measured at 5.0, 2.7, and 1.4 GHz, and its position and an upper limit to the angular size at 5 GHz were estimated. In addition, the HI absorption spectrum was determined and upper limits placed on the flux densities at 150 and 81.5 MHz. The instruments used were the 5 km, 1 mile, and half-mile telescopes, the 4C antenna, and the 4½ acre array. Flux densities are shown in graphical form. Further outbursts were observed, including a flux density rise of 45% at 5 GHz during a 3 hr period. Linear and circular polarizations were determined to be <2%. No evidence was found for any change in position during the observations. The cross-correlation line receiver on the half-mile telescope was used to measure the HI absorption spectrum, the data for which implied a distance >8 kpc, but probably <11 kpc for Cyg X-3. An upper limit of 0.6 arc could be placed on the angular size of the source at 5 GHz, and if the distance is about 10 kpc, the upper limit on the linear size is ~0.02 pc. (UK)

5873 OH AND FORMALDEHYDE ABSORPTION IN THE DIRECTION OF CYGNUS X-3. Turner, B. E. (National Radio Astronomy Observatory, Charlottesville, VA). Nature (London) Phys. Sci.; 239: No. 95, 132-3(23 Oct 1972).

Observations of all four 18 cm lines of OH were made during the later stages of the recent Cyg X-3 outbursts—also the 6 cm line of formaldehyde—using the 140 ft telescope of the National Radio Astronomy Observatory; with a 413 channel autocorrelation receiver. In addition the 1665 and 1667 MHz lines of OH were observed in a number of other directions in the Cygnus X complex. The OH spectrum at 1667 MHz in the direction of Cyg X-3 is shown, together with the 6 cm line of formaldehyde. A distance of 8 to 11 kpc for Cyg X-3 has been suggested based on 21 cm H absorption data, but the OH and formaldehyde absorption data suggest the possibility of a much smaller distance of 3 kpc or less. The question hinges on whether or not the 12 km/s feature of the latter, seen only in the direction of Cyg X-3, is actually associated with this object or with more distant sources; but unless it is as-

sumed that this feature is associated with Cyg X-3 it is difficult to draw any definite conclusions about its distance. Because of the complicated distribution of H, OH, and probably formaldehyde in the Cyg X region interferometric observations of their absorption are needed to establish a reliable picture. (UK)

5874 21 CM AND 18 CM OBSERVATIONS OF THE CYGNUS X-3 RADIO OUTBURST. Shaffer, D. B.; Shields, G. A.; Schupler, B. (California Inst. of Tech., Pasadena). Nature (London) Phys. Sci.; 239: No. 95, 131-2(23 Oct 1972).

The recent outburst of Cyg X-3 was observed at 21 cm using the Owens Valley Radio Observatory interferometer at Pasadena, and at 18 cm with the 130 ft antenna. The observing frequency was initially 1418 MHz and subsequently 1410 MHz. Data for flux density and phase are shown tabulated. The most salient features in the data are the rapid rise in intensity at 21 cm at the beginning of the outburst and the apparently irregular decay at 18 cm, indicating that the outburst had periods of constant or even increasing luminosity during its decay phase. The outburst was less than 5% polarized, and it seems unlikely that polarization influenced the results. The observations were hampered by inadequate knowledge of the radio surroundings of Cyg X-3. (UK)

5875 DISCOVERY OF INFRARED EMISSION FROM THE RADIO SOURCE NEAR CYGNUS X-3. Becklin, E. E.; Kristian, J.; Neugebauer, G.; Wynn-Williams, C. G. (Carnegie Institution of Washington, DC). Nature (London) Phys. Sci.; 239: No. 95, 130-1(23 Oct 1972).

Four weeks after the recent radio outburst near Cygnus X-3 a search was made for infrared emission at the radio position, and an infrared source was discovered at 2.2 and 1.6 μm, the measured flux densities of which are tabulated. The observations were made with the Hale 200 in. telescope and infrared photometer. The infrared source position was 1.5 arc s W and 0.5 arc s S of the radio source position. The source was discrete, with a diameter <7 arc s and no statistically significant variation in the source was detected during the period of observation. At the time the radio source was steady and comparatively weak. Association of the infrared source with the radio source rests at present on positional agreement, but the likelihood of chance association is thought to be small. Speculation is offered regarding the nature of the source; it appears to be at least as bright as an early 0 star, and it is probably heavily reddened, and may be at a distance of 10 kpc. (UK)

5876 NATURE OF THE FIRST CYGNUS X-3 RADIO OUTBURST. Gregory, P. C.; Kronberg, P. P.; Seaquist, E. R.; (and others) (Univ. of Toronto). Nature (London) Phys. Sci.; 239: No. 95, 114-17(23 Oct 1972).

The data for the event observed in Cyg X-3 early in September 1972 at many wavelengths indicate that the radio outburst originated in an expanding cloud of synchrotron emitting electrons. Details of the radiation mechanism and limits on models are discussed. (auth)

5877 OBSERVATIONS AT 408 MHz OF THE CYG X-3 RADIO OUTBURST. Anderson, B.; Conway, R. G.; Davis, R. J.; (and others) (Univ. of Manchester, Eng.). Nature (London) Phys. Sci.; 239: No. 95, 117-18(23 Oct 1972).

Observations of the Cygnus X-3 outburst were made with interferometers operating at 408 MHz at Jodrell Bank. The data are consistent with a model in which the source has a true angular diameter of ~0.1 arc(s) which is increased to the apparent value by interstellar scattering. The true size of the source is thus ~2 light days at ~4 kpc. (auth)

5878 DETERMINATION OF THE DISTANCE OF CYGNUS X-3 BY 21-CM ABSORPTION. Lauque, R.; Lequeux, J.; Rieu, N. Q. (Observatoire de Paris, Meudon, France). Nature (London) Phys. Sci.; 239: No. 95, 119-20(23 Oct 1972).

It is stated that the recent radio outburst of the x-ray source Cygnus X-3 provided a unique opportunity for measuring its distance, using H line absorption in front of its radio counterpart. By this method the distance to Cyg X-3 was determined to be 8 to 11 kpc. In this work the 21 cm absorption spectrum in front of Cyg X-3 was observed with the Nancay radio telescope. Among matters discussed is the spin temperature of the H in the features responsible for the observed 21 cm absorption; the apparent value was found to be ~75°K, but the actual value may be somewhat smaller, since the optical depths may have been underestimated. The 21 cm continuum flux variations showed a time scale of the order of 2 days; this implies that the linear size of the radio source is $<1.8 \times 10^{-3}$ pc, and at a minimum distance of 8kpc the angular diameter of the source is <0.045 arc s. The high brightness temperature appears to indicate a nonthermal mechanism for the radio emission. (UK)

5879 LIMITS TO THE 2695 MHz CIRCULAR POLARIZATION OF THE SEPTEMBER CYG X-3 FLARE. Bridle, A. H.; Kesteven, M. J. L.; Niell, A. E. (Queen's Univ., Kingston, Ont.). Nature (London) Phys. Sci.; 239: No. 95, 121(23 Oct 1972).

The decay of the first September 1972 Cyg X-3 radio outburst was observed at 2695 MHz (λ11 cm) with the resurfaced 300 ft meridian transit telescope of the Canadian National Radio Astronomy Observatory. An on-axis feed system provided both LH and RH circular polarizations, and the total flux density and circular polarization measurements are tabulated. Limits to the circular polarization are inferred. (UK)

5880 ATTEMPT TO DETECT RECOMBINATION LINE EMISSION FROM THE CYGNUS X-3 OUTBURST. Leslie, B. G.; Dent, W. A. Nature (London) Phys. Sci.; 239: No. 95, 126 (23 Oct 1972).

Shortly after the recent Cyg X-3 outburst had reached its maximum attempts were made to detect possible recombination line emission in the source. The observations were made at the frequency of the H 92α line (8309.28 MHz) with a 100°K system noise temperature parametric amplifier receiver on the 120 ft Haystack Observatory Antenna. No recombination line was found having an amplitude >0.03°K in antenna temperature or 0.2×10^{-26} W/m^2/Hz in flux density. The continuum flux density of Cyg X-3 was also measured relative to the nearby source DR 21. The measurements placed an upper limit of 1% on the line-to-continuum ratio of the 92α line. This limit is well below that in normal H II regions and implies that if a thermal model for the outburst is applicable, as seems very unlikely, than either the line is more highly Doppler broadened or the temperature is much greater than that in ordinary H II regions. (UK)

5881 OBSERVATIONS OF CYGNUS X-3 AT 2.8 CM WITH A 17 ARC S BEAM. D'Addario, L. R.; Stull, M. A. (Radio Astronomy Inst., Stanford, CA). Nature (London) Phys. Sci.; 239: No. 95, 120-1(23 Oct 1972).

Observations of Cygnus X-3 made at 2.8 cm (10,690 MHz) during its September 1972 outburst, using the five element minimum redundancy array at Stanford University are described. Estimates of the structure were made, together with the ratio of flux density relative to PKS 2134 + 00. In all the observations Cygnus X-3 was unresolved, implying that any angular structure must have been on a scale <17 arc s and a more stringent upper limit was placed on the angular size. Estimates of the flux density are shown tabulated, not including a polarization correction. (UK)

5882 LARGE OUTBURST IN CYGNUS X-3 AT 8 GHz. Aller, H. D.; Dent, W. A. (Univ. of Michigan, Ann Arbor). Nature (London) Phys. Sci.; 239: No. 95, 121-3(23 Oct 1972).

The results of observations of Cygnus X-3 at 8 GHz during the decay phase of the recent outburst are described. The measurements were made with the University of Michigan 85 ft paraboloid and results are compared with the flux density variation observed with the Haystack 120 ft telescope at 15.5 GHz. A possible model for the source is discussed. No strong thermal sources were observed at the position of Cygnus X-3. Flux densities at 8 GHz are tabulated and shown graphically. The outstanding feature was the precise exponential decay of the flux density variation with time. Spectral index values are also tabulated as a function of time. Some process in addition to a simple exponential decay was also apparently affecting the 8 GHz flux during the first day of the decay phase, the spectrum between 8 and 15.5 GHz steepening from $\alpha = -0.44$ to a terminal value of $\alpha = -0.71$; this was believed not to be the result of synchrotron losses. Possible processes producing the radio emission are discussed, but the actual process is uncertain. The form of decay was similar to those of solar cm wavelength bursts, suggesting the same type of process, but on a much larger scale. It is suggested that the radio emission is produced by synchrotron radiation, but that the exponential decay of the flux density with time results from bremsstrahlung losses produced by Coulomb collisions between the relativistic particles and an ambient thermal plasma. Most of this bremsstrahlung would be in the form of γ rays because of the high energies of the particles. Certain limits on the physical parameters within the source were obtained, including the average magnetic field strength seen by the emitting particles. Both the high ambient density and the inhomogenous suggest that the emitting region is situated in a "stellar" atmosphere. A possible source model is an emitting region in an extended atmosphere, with the relativistic particles confined by a magnetic field with a loop-like structure. (UK)

5883 OBSERVATIONS OF CYGNUS X-3 BY UHURU. Parsignault, D. R.; Gursky, H.; Kellogg, E. M.; (and others) (American Science and Engineering, Inc., Cambridge, MA). Nature (London) Phys. Sci.; 239: No. 95, 123-5(23 Oct 1972).

Observations of Cygnus X-3 during its recent outburst by the x-ray satellite Uhuru are described. The x-ray intensity did not seem to be anomalous and there did not appear to be any indication of a systematic intensity change coincident with the radio flare. Assuming the radio and x-ray source to be the same object it is concluded that whatever precipitated the radio event did not have a significant effect on the x-ray emitting region. Characteristics of Cyg X-3 are briefly reviewed. It is pointed out that the only basis for identification of Cyg X-3 with the radio source is the positional coincidence. (UK)

5884 X-RAY OBSERVATIONS OF CYG X-3 NEAR THE TIME OF RADIO OUTBURSTS. Conner, J. P.; Evans, W. D.; Mook, D. E. (Los Alamos Scientific Lab., NM). Nature (London) Phys. Sci.; 239: No. 95, 125(23 Oct 1972).

A search was made through all available Vela B spacecraft data for dates near that of the recent radio outburst of Cyg X-3 to determine if any associated increase in x-ray flux could be detected. Any long term (≳100 hr) outburst in the x-ray region of the spectrum from about 8 days prior to 1 day following the increase observed in radio flux appears to be ruled out. (UK)

5885 CYGNUS X-3: 3.3 MM OBSERVATIONS. Pomphrey, R. B.; Epstein, E. E. (Aerospace Corp., El Segundo, CA). Nature (London) Phys. Sci.; 239: No. 95, 125-6(23 Oct 1972).

Observations of the September 1972 flare of the radio counterpart of Cyg X-3 were made at 90 GHz with the 4.6 m antenna at the Aerospace Corporation, Los Angeles. Total fluxes are shown tabulated. (UK)

5886 ABSENCE OF LINEAR POLARIZATION IN CYGNUS X-3. Aller, H. D. (Univ. of Michigan, Ann Arbor). Nature (London) Phys. Sci.; 239: No. 95, 128(23 Oct 1972).

Some linear polarization measurements of the recent Cyg X-3 outburst were made with the University of Michigan 85 ft telescope at 8 GHz. Linear polarization was not detected at any time during the outburst. Mechanisms that intrinsically produce unpolarized radiation, such as thermal bremsstrahlung, cannot produce the observed radio spectrum of the outburst, and synchrotron radiation appears to be the most likely source of the emission. At present a clear choice cannot be made, but Faraday depolarization seems to be the most likely cause of the low degree of linear polarization in Cyg X-3. The x-ray spectrum indicates that $\gtrsim 10^{23}/cm^2$ atoms of gas may lie in the line of sight to the x-ray source, and strong Faraday depolarization would be expected if the radio emitting region is situated in a high-density plasma, as has been proposed. (UK)

5887 RADIO OBSERVATIONS OF CYGNUS X-3 AND THE SURROUNDING REGION. Gary, B.; Olsen, E. T.; Rosenkranz, P. W. (California Inst. of Tech., Pasadena). Nature (London) Phys. Sci.; 239: No. 95, 128-30(23 Oct 1972).

During its recent outburst Cygnus X-3 was observed with the Goldstone 64 m antenna at wavelengths of 13.1, 3.55, and 1.95 cm. A map of received flux density at 13.1 cm was constructed for a region 0.5 × 0.6 arc degree, with a resolution of 8.15 arc min. This map revealed the presence of several partially resolved features having integrated flux densities in excess of 1 fu; and an unresolved source very near the predicted position of Cyg X-3; this source was in fact identified as Cyg X-3, with a strength of 1.05 ± 0.16 fu. The map also shows a source 11 arc min N and 5 arc min W of Cyg X-3, with an integrated flux of 2.0 ± 0.7 fu, and a feature 5 arc min S and 22 arc min W of Cyg X-3 with a peak intensity of 1.3 fu and of indeterminate size. The strongest feature of the radio map is a partially resolved ridge approximately 20 arc min to the NW of Cygnus X-3. Intensity measurements of Cygnus X-3 at the three wavelengths are shown tabulated. (UK)

5888 SPECTRUM AND POLARIZATION OF THE CYGNUS X-3 OUTBURST. Dent, W. A. (Univ. of Massachusetts, Amherst). Nature (London) Phys. Sci.; 239: No. 95, 127-8(23 Oct 1972).

The recent large outburst of Cygnus X-3 was observed with the 300 ft antenna at the National Radio Astronomy Observatory at a frequency of 2.7 GHz and the flux density and linear polarization measured. The measured degree of linear polarization was 0.007 ± 0.005, showing that the outburst was not highly polarized, and the measured flux density was $12.8 \pm 0.4 \times 10^{-26}$ W/m²/Hz. The radio spectrum of the outburst is shown. The observed spectrum was characteristic of that observed in many compact radio sources in that it was of a normal nonthermal type at the higher frequencies and showed a sharp low-frequency cutoff. Such a spectrum is usually attributed to synchrotron emission that becomes self-absorbed at lower frequencies. Two other possible mechanisms that could be responsible for the low-frequency cutoff are free–free absorption or a refractive index in the emitting region that differs from unity; these are discussed. An upper limit of 0.008 arc S on the angular diameter of the source could be placed, and if Cyg X-3 is at a distance of 2.1 kpc then an upper limit to the size of the source is 3×10^{14} cm or 20 AU, a factor of ten smaller than that inferred from the time scale of the variation in the radio emission. An estimate of the radio luminosity of the outburst at maximum was obtained by integrating the spectrum over frequencies below 10^{11} Hz and found to be 6×10^{33} erg/s, assuming a distance of 2.1 kpc. (UK)

5889 15.5 GHz OBSERVATIONS AT THE HAYSTACK OBSERVATORY OF THE CYGNUS X-3 OUTBURST. Dent, W. A.; Kapitzky, J. E.; Leslie, B. G.; (and others) (Univ. of Massachusetts, Amherst). Nature (London) Phys. Sci.; 239: No. 95, 126-7(23 Oct 1972).

The recent outburst in Cygnus X-3 was observed at 15.5 GHz with the 120 ft antenna of the NEROC Haystack Observatory. Measurements included the flux density of the continuum emission when the outburst was near maximum, followed by measurements during the rapid decay period. Results are shown tabulated. The effect of any source polarization or linearly sloping background component was canceled by the observing technique. The logarithm of the 15.5 GHz flux density is shown plotted against time, and shows that the past maximum emission of the outburst decayed exponentially with time by two orders of magnitude. The measured characteristic decay time for the outburst is 27.28 ± 0.26 hr. From other observations it was possible to place an upper limit of <10 arc s to the angular diameter of the radio source associated with Cyg X-3 at the time of outburst maximum, and a lower limit on the 15.5 GHz brightness temperature of $\gtrsim 10^3$ K near outburst maximum. This limit does not exclude a thermal model for the source, but the spectral index of −0.7 obtained by combining the 15.5 GHz measurements with those at 8 GHz implies that the source is nonthermal. (UK)

5890 INTERSTELLAR EMISSION LINE FROM ISOCYANIC ACID AT 1.4 CENTIMETERS. Buhl, David (National Radio Astronomy Observatory, Green Bank, VA.); Snyder, L. E.; Edrich, Jochen. Astrophys. J.; 177: No. 3, 625-8(1 Nov 1972).

An earlier identification of interstellar isocyanic acid (HNCO) was confirmed by detection of a second transition at 1.4 cm in the galactic-center source Sgr B2. An excitation temperature of 12.8° K was obtained from the ratio of the two lines. A search for the $1_{01}-0_{00}$ transition of formic acid (HCOOH) was negative. (auth)

5891 INTERSTELLAR ISOCYANIC ACID. Snyder, L. E. (Univ. of Virginia, Charlottesville); Buhl, David. Astrophys. J.; 177: No. 3, 619-23(1 Nov 1972).

Interstellar isocyanic acid (HNCO) was detected in emission through the $4_{04}-3_{03}$ ground-state rotational transition at 3.4 mm. Out of nine galactic sources surveyed, HNCO was observed only in the direction of Sgr B2 and possibly W51. The Sgr B2 emission pattern was fairly extensive, and the observations indicated that the peak HNCO emission was ~2′ north of the OH position. A search for the 7–6 transition of interstellar OCS yielded negative results. (auth)

5892 DETECTION OF THE 4_1-3_0 (E_2) LINE OF INTERSTELLAR METHYL ALCOHOL. Turner, B. E. (National Radio Astronomy Observatory, Green Bank, W. Va.); Gordon, M. A.; Wrixon, G. T. Astrophys. J.; 177: No. 3, 609-17(1 Nov 1972).

The $4_1 \rightarrow 3_0$ (E_2) transition of methyl alcohol (CH_3OH) at 36,169 MHz was detected with a total strength of ≥120 flux units (f.u.) in two extended clouds in Sgr B2. The line is not present to a limit of ~30 f.u. in Ori A or in several other sources. This new line is further evidence, in addition to that of the recently detected $5_1 \rightarrow 4_0$ (E_2) transition, that the interstellar CH_3OH molecule is anomalously excited in most, if not all, of the transitions that have so far been detected in the interstellar medium. Limits are given to other molecular lines searched for but not detected in the range 28 to 40 GHz. (auth)

5893 NEW INTERSTELLAR LINE: THE 5_1-4_0 (E_2) TRANSITION IN METHYL ALCOHOL. Zuckerman, B. (California Inst. of Tech., Pasadena); Turner, B. E.; Johnson, D. R.; Palmer, Patrick; Morris, M. Astrophys. J.; 177: No. 3, 601-7(1 Nov 1972).

An emission line was detected at 84.5 GHz in the direction of the radio continuum source Sgr B2. The new line frequency was found to coincide with a laboratory measurement of the 5_1-4_0 (E_2) transition of methyl alcohol (CH_3OH). Calculations of the spontaneous emission rates from all energy levels of astrophysical interest were performed; these indicate that not only the 5_1-4_0 (E_2) transition in Sgr B2 but also the $\Delta J = 0$, $\Delta K = 1$ (E_1) transitions discovered in Orion A by Barrett et al. are likely to have population inversions. Additional searches for NH_2CN, HCP,

CH_3Cl, ClCN, FeO, HC_3HO, and NH_2HCO were carried out in the 80 to 92-GHz region without success. (auth)

5894 DISTRIBUTION OF RADIATION FROM RELATIVISTICALLY EXPANDING RADIO SOURCES. De Young, D. S. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. J.; 177: No. 3, 573-83(1 Nov 1972).

The distribution of synchrotron radiation in a relativistically expanding source is considered as seen by a distant observer. A variety of initial conditions, optical depths, and geometries are examined, including sources of constant energy input, blast waves, and jets. It is found that double or core-and-halo sources with apparent expansion velocities in excess of the velocity of light can result from natural geometries and actual expansion rates less than c. The results are compared with observations of 3C 279, 3C 273, and 3C 120, all of which exhibit possible "superrelativistic" expansions. (auth)

5895 PULSAR GLITCHES AND THE METASTABILITY OF THE SUPERFLUID CORE. Banerji, S. (Inst. for Advanced Studies, Dublin); Chanda, R. Nature (London) Phys. Sci.; 239: No. 96, 139-40(30 Oct 1972).

It has been suggested that the glitches in the Crab and Vela pulsars may be caused by transitions between metastable flow states in the superfluid interior of the neutron star. This is discussed from the angular momentum point of view. It is found that the theory leading to this suggestion meets with difficulty in explaining the large difference in the magnitude of the glitches of the two pulsars consistent with the accepted lower limit of the mass of the Crab pulsar. (UK)

5896 ROTATIONAL ENERGY, PULSARS, AND ACTIVE NEBULAE. Cohen, J. M. (Inst. for Advanced Study, Princeton, NJ). Gen. Relativity Gravitation; 3: No. 3, 221-5(Oct 1972).

A number of different expressions for the rotational energy of a slowly rotating star have appeared in the literature. Here it is shown that these expressions are equivalent. Application to pulsars and the Crab Nebulae is discussed. (auth)

5897 OBSERVATIONS OF METHANOL IN SAGITTARIUS B2 AT 48 GHz. Barrett, A. H. (Massachusetts Inst. of Tech., Cambridge); Martin, R. N.; Myers, P. C.; Schwartz, P. R. Astrophys. J.; 178: No. 1, L23-7(15 Nov 1972).

The J,K = 1,0 → 0,0 lines of methanol at 48.3 GHz were detected in both Sgr A and Sgr B2 OH. The Sgr B2 emission was found to extend over an area at least $5' \times 10'$. The indicated column density of methanol was $\sim 2 \times 10^{16}$ cm^{-2}, and the total mass of the neutral cloud estimated to be $\sim 10^6$ $M_\odot$. (auth)

5898 COLOR–MAGNITUDE LOCUS OF SCORPIUS X-1. Mook, D. E. (Dartmouth Coll., Hanover, NH); Blanco, V.; Hesser, J.; Kunkel, W.; Lasker, B. Astrophys. J.; 178: No. 1, L11-12(15 Nov 1972).

Recent simultaneous observations of Sco X-1 in V and B are shown to define a color-magnitude relation in agreement with those obtained in previous observing seasons. (auth)

5899 PULSE SHAPE OF THE CRAB NEBULA PULSAR NP 0532 AS A FUNCTION OF COLOR. Muncaster, G. W.; Cocke, W. J. (Univ. of Arizona, Tucson). Astrophys. J.; 178: No. 1, L13-15(15 Nov 1972).

Differences were found in the shape of the secondary pulse of NP 0532 in U, B, and V. The leading edge and peak were stronger at higher frequencies, relative to the trailing edge. The peak difference was about 3% between the U and the V. (auth)

5900 PULSARS AND THE EVOLUTION OF SUPERNOVA REMNANTS. Setti, G. (Univ., Bologna); Woltjer, L. Astrophys. J.; 178: No. 1, L17-19(15 Nov 1972).

If pulsars are responsible for the particle acceleration in the remnants and if the main-energy loss is due to the expansion, then the radio flux of young supernova remnants is expected to be well below that obtained by extrapolating the flux–radius relation of older remnants to small radii. The periods of the pulsars would be comparable to those found in the Crab and Vela. (auth)

5901 $^{13}C^{16}O/^{12}C^{18}O$ RATIOS IN NINE H II REGIONS. Penzias, A. A.; Jefferts, K. B.; Wilson, R. W.; Liszt, H. S.; Solomon, P. M. Astrophys. J.; 178: No. 1, L35-8(15 Nov 1972).

Observations of the J = 1 to 0 transitions in $^{13}C^{16}O$ and $^{12}C^{18}O$ were made in nine H II regions. In each source the intensity ratio of these lines was found to be within a factor of 2 of the terrestrial ratio of 5.5. (auth)

5902 SEARCH FOR SEISMIC SIGNALS FROM GRAVITATIONAL RADIATION OF PULSAR CP1133. Mast, T. S.; Nelson, J. E.; Saarloos, J.; Muller, R. A.; Bolt, B. A. (Univ. of California, Berkeley). Nature (London); 240: No. 5377, 140-2(17 Nov 1972).

Attempts to derive seismic signals from CP 1133 were unsuccessful. Possible experimental errors in previous work are discussed. (auth)

5903 PERIODICITIES IN SEISMIC RESPONSE CAUSED BY PULSAR CP1133. Sadeh, D.; Meidav, M. (Tel Aviv Univ., Israel). Nature (London); 240: No. 5377, 136-8(17 Nov 1972).

A seismometer/computer combination has detected seismic vibrations corresponding to the half-period of pulsar CP 1133. A hitherto unknown pulsar may also have been detected by the same technique. (auth)

Solar Phenomena

Refer also to abstracts 5957, 5967, and 6777.

5904 (AD–740862) INVESTIGATION OF SOLAR FLARES AND ASSOCIATED PLAGE PHENOMENA. Final Technical Report, June 1, 1969–May 31, 1970. Ishitsuka, Mutsumi; Lanat, Jean (Instituto Geofisico, Lima (Peru)). 31 May 1970. 49p. (AFCRL–72–182). NTIS.

The observations of the solar chromosphere were monitored by a monochromatic heliograph with lyot filter. Radiotelescopic observations were made of solar radio emission at 9400 MHz. Modifications of the shutter system in the heliograph were described and repair of the filter was necessary. A modification of the counter weight of the monochromatic heliograph was performed. (GRA)

5905 (AD–741842) STRUCTURE AND HEATING OF THE CHROMOSPHERE-CORONA TRANSITION REGION. Moore, R. L. (Stanford Univ., Calif. Inst. for Plasma Research). Mar 1972. Contract F44620-69-C-0008. 142p. (SU-IPR-463; AFOSR-TR-72-984). NTIS.

A broad endeavor of solar physics is to determine from the observed radiation the structure of the solar atmosphere and the nature of the energy balance which this structure implies. A basic feature of the solar atmosphere which is still not well understood is the chromosphere–corona transition region in which, in a height of a few thousand kilometers, the temperature increases from about 10,000 degrees K at the top of the chromosphere to about 1,000,000 degrees K at the bottom of the corona. The problem investigated in this dissertation is that of the structure and heating (or energy balance) of the transition region and the role of the transition region in the structure and heating of the atmosphere as a whole. (auth) (GRA)

5906 (AD–742982) OBSERVATIONS OF THE 1.4 MM BRIGHTNESS DISTRIBUTION OF THE SUN. Report for October 1967–October 1968. Shimabukuro, F. I. (Aerospace Corp., El Segundo, Calif.). 25 May 1972. Contract F04701-71-C-0172. 19p. (SAMSO-TR-71-119). NTIS.

Observations of the 1.4 mm center to limb solar brightness distribution show that there is little, if any, limb brightening at this wavelength. Knowledge of the antenna radiation pattern is vital in interpreting the radio measurements. (auth) (GRA)

5907 (AD–743124) FREE–FREE ABSORPTION OF GYROSYNCHROTRON RADIATION IN SOLAR MICROWAVE BURSTS. Ramaty, Reuven; Petrosian, Vahe (Stanford Univ., Calif. Inst. for Plasma Research). 28 Apr 1972. Contract N00014-67-A-0112-0062. 27p. (SU-IPR-465). NTIS.

A model for solar microwave bursts is considered in which over a broad frequency band the flux density is a slowly varying function of frequency. It is proposed that such an essentially flat spectrum could result from free–free absorption of gyrosynchrotron emission of nonthermal electrons accelerated in solar flares. The theory of gyrosynchrotron radiation is reviewed, and simplified formulae for the Razin effect, self-absorption and gyroresonance absorption are given and their range of validity is discussed. Using these results the thermal electron density, temperature, emission measure, magnetic fields and number of nonthermal electrons in the emitting region are evaluated for a flare with a flat microwave spectrum. (auth) (GRA)

5908 (AD–745331) COSMIC RAY RESEARCH. Final Report, December 1, 1963–July 1, 1972. Cowan, E. W. (California Inst. of Tech., Pasadena. Dept. of Physics). 20 Jul 1972. Contract N00014-67-A-0094-0016. 4p. NTIS.

The research conducted under this contract has been divided into two main efforts; measurements of cosmic-ray intensity in and above the atmosphere as a function of altitude, latitude, and time through several solar cycles and measurements of the in-

teractions of high-energy cosmic rays at sea level and improvements in the instruments used in such measurements. The results are summarized in the publications listed. (auth) (GRA)

5909 (AD-745576) ELECTRON-TEMPERATURE ASYMMETRY AND THE STRUCTURE OF THE SOLAR WIND. Report for September 1969–June 1971. Schulz, M.; Eviator, A. (Aerospace Corp., El Segundo, Calif. Tel Aviv Univ. (Israel)). 30 May 1972. Contract F04701-71-C-0172. 51p. (SAMSO-TR-72-162). NTIS.

The observational fact that, in the frame of the solar wind, outgoing thermal electrons have a somewhat larger mean energy than those incoming corresponds to an outward "heat flow" that can be simulated in the extreme by an exospheric model. In the present work, microinstabilities of the interplanetary plasma are studied within the framework of an underlying electron–proton solar exosphere. Although collisions are neglected by definition, heat-flow moments of the distribution functions are significantly bounded by virture of geometry. This fact permits velocity-space instabilities driven by heat flow to be analyzed under the most extreme conditions (exospheric) conceivably attainable. (auth) (GRA)

5910 CIRCULAR POLARIZATION OF THE NIGHTSKY RADIATION. Wolstencroft, R. D.; Kemp, J. C. (Univ. of Hawaii, Honolulu). Astrophys. J.; 177: No. 3, L137-40(1 Nov 1972).

The fractional circular polarization, q, of the night sky was measured in 13 directions. Definite values (at least 3 σ) were found in four regions of the zodiacal light and two areas of the Milky Way. The values of q, when corrected for foreground radiation, range from −0.6 to +0.5 percent and agree well with results reported recently by Staude, Wolf, and Schmidt. Scattering of light by nonspherical particles that are partially aligned can explain these observations. (auth)

5911 HYDRODYNAMICS OF A CONVECTIVE ZONE OF THE SUN. Keller, B. S.; Yavorskaya, I. M. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 5, 23-32(1972). (In Russian).

Large-scale hydrodynamic movements of the Sun under the influence of rotation and the turbulent convective transfer of heat were studied. The compressibility of solar matter, density stratification, and anisotropy of its viscosity were taken into consideration. Solutions for the functions of meridional motion and angular rotational velocity were found in the form of infinite series. For weak anisotropy of turbulent pulsations $s \sim 1.1$, the zonal depth found was 0.27 of the Sun's radius, the effective viscosity $\eta/\rho \sim 10^{14}$ cm^2/sec, and the density differential in the zone was 2×10^6, which arose from the differential rotation and may be attributed to the observed equatorial acceleration of the Sun. (tr-auth)

5912 HIGH-RESOLUTION FOURIER SPECTROSCOPY AND POLARIMETRY OF SOLAR RADIO EMISSION AT 34 MHz. Dodge, James Cecil. Boulder, Colo.; Univ. of Colorado (1972). 158p. University Microfilms Order No. 72-25,158.

Thesis.

Measurements were made of high-resolution spectral and polarization behavior of solar Type III bursts at 34 MHz. The polarimeter operated with a total bandwidth of 3 kHz; its output was analyzed by Fourier spectroscopy to ~5 Hz resolution. (TSS) (Diss. Abstr. Int., B)

5913 K-SHELL PHOTOIONIZATION CROSS-SECTIONS. Daltabuit, Enrique; Cox, D. P. (Univ. of Wisconsin, Madison). Astrophys. J.; 177: No. 3, 855-9(1 Nov 1972).

Approximate values for the threshold energies, threshold cross-sections, and the energy dependence of the cross-sections for K-shell photoionization are tabulated for H, He, C, N, O, Ne, Mg, Si, and S in all stages of ionization. (auth)

5914 OSCILLATOR STRENGTHS OF WEAK Fe I RESONANCE LINES MEASURED BY COMBINED HOOK AND ABSORPTION TECHNIQUES. Huber, M. C. E.; Tubbs, E. F. (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. J.; 177: No. 3, 847-54(1 Nov 1972).

Oscillator strengths of nine weak Fe I resonance lines (Multiplet 1, λλ5110–5255) determined from nearly simultaneous hook and photoelectric absorption measurements are presented. Comparison of these results with the commonly used oscillator strengths of Corliss and Tech supports the hypothesis of Bell and Upson that the data reflect an intensity-dependent error. The size of the intensity correction determined from the results is somewhat larger than that predicted by Bell and Upson. (auth)

5915 WAVES IN THE SOLAR ATMOSPHERE. II. LARGE-AMPLITUDE ACOUSTIC PULSE PROPAGATION. Stein, R. F. (Brandeis Univ., Waltham, Mass.); Schwartz, R. A. Astrophys. J.; 177: No. 3, 807-28(1 Nov 1972).

Numerical experiments are performed with vertically propagating acoustic pulses by solving the nonlinear equations of fluid motion using a finite-difference technique. The pulse energy, dissipation, wake, and atmospheric heating are investigated, and the results compared with weak-shock theory. The ratio of pulse frequency to the acoustic cutoff frequency, $N_{ac} = \gamma g/2c$, is found to be a crucial parameter. Weak-shock theory gives reasonable results for pulse widths less than 50 seconds ($\omega > 2N_{ac}$), but greatly overestimates the pulse energy and dissipation for longer pulses. Significant dissipation begins at the height where the crest of a simple wave overtakes its trough. For pulses with $\omega > 2N_{ac}$ the minimum damping length is about 500 km and occurs at about 1000 km above $\tau_{5000} = 1$. For lower-frequency pulses the minimum damping length is about 1000 km and occurs higher up. Until hydrogen is nearly completely ionized, ionization and radiation keep the temperature rise small. (auth)

5916 TEMPERATURE-DENSITY STRUCTURE IN CORONAL HELMETS: THE QUIESCENT PROMINENCE AND CORONAL CAVITY. Pneuman, G. W. (National Center for Atmospheric Research, Boulder, Colo.). Astrophys. J.; 177: No. 3, 8793-805(1 Nov 1972).

Physical processes which are most important in determining temperature and density distributions in closed coronal loop systems are studied within the context of how this type of magnetic geometry influences the local balance of mechanical energy flux, conductive flux, and radiative losses. For regions above the temperature maximum, there can be no net conductive loss since closed field lines prevent outward heat conduction and the vanishing temperature gradient at the level of the temperature maximum prohibits downward heat conduction there. Hence, the mechanical energy input at the base must ultimately be radiated away. This requirement, in addition to a condition on the lateral distribution of gas pressure at the level of T_{max}, is used in a computation which yields the density and temperature distribution throughout the helmet as a function of the mechanical energy input and magnetic field geometry. It is demonstrated that the quiescent prominences normally observed at the base of coronal helmets as well as the low-density cavity surrounding these structures are the natural consequences of the adjustment of density and temperature structure in the helmet required to satisfy energy and mass balance conditions as modulated by the magnetic field. (auth)

5917 DIFFERENCE IN FRAUNHOFER LINES IN THE SPECTRUM OF THE POLE AND THE EQUATORIAL DISC OF THE SUN. Kuli-Zade, D. M.; Solonskii, Yu. A. Soobshch. Shemakhinskoi Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 6, 25-43 (1971). (In Russian).

Contour differences, equivalent widths, and central intensities of 168 selected Fraunhofer lines were examined in a spectrum of the center of the Sun's disc and that of points near the poles of the Sun. Previous observations are reviewed, the instrumentation and methods employed are briefly described, and several pages of the data obtained are presented. 30 references. (K.S.W.)

5918 BODE'S LAW AND THE MISSING PLANET. Ovenden, M. W. (Univ. of British Columbia, Vancouver). Nature (London); 239: No. 5374, 508-9(27 Oct 1972).

Reference is made to Titius's orbital rule for the mean distances of the planets from the Sun, published in 1772. This rule predicted the discovery of Uranus, after which it became known as Bode's Law. Whilst the law is not of precise physical significance, it has long been a problem whether the distribution of planetary orbits is due to chance or to some physical principle that would operate in any planetary system. Possibilities are concerned with (i) the properties of the mechanism of formation of the solar system, (ii) mutual planetary perturbations subsequent to the formation of the solar system, such perturbations being either simple point-mass gravitational perturbations, or else perturbations involving dissipative forces, such as tidal action. The author has shown that point-mass perturbations, without dissipative forces, are a sufficient explanation of the existing distribution of orbits and planetary distances, and arguments for this are advanced. The obvious conclusion that a set of planets will rapidly change their configuration when their mutual interactions are strong, and only slowly when interactions are weak, is confirmed by numerical integrations of simulated satellite systems, and is generalized into a "principle of least interaction action", tests of which are discussed. Large discrepancies arise on application to the Jupiter, Saturn, Uranus, Neptune system, but these may be removed if it is assumed that material of mass $90 \pm 5M_E$, where M_E is the mass of the Earth, had been in the asteroid belt from the beginning of the solar system until $1.6 \pm 0.4 \times 10^7$ yr ago, and then became dissipated. Major problems remaining are concerned with what physical process caused the sudden dissipation, and what happened to the dissipated material. (UK)

5919 REACTION RATES IN THE PROTON–PROTON CHAIN. Kavanagh, R. W. (California Inst. of Tech., Pasadena). pp

169-85 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

The present situation regarding laboratory measurements pertinent to the solar proton–proton chain is summarized. (W.D.M.)

5920 SUNSPOTS AND PLANETS. Wood, K. D. (Univ. of Colorado, Boulder). Nature (London); 240: No. 5376, 91-3 (10 Nov 1972).

It is stated that most current literature on solar activity assumes that the planets do not affect it, and that conditions internal to the Sun are primarily responsible for the solar cycle. It has been shown, however, that the period of Mercury's orbit is reflected in sunspot data, and that the influence of Mercury depends on the phases of Venus, Earth, and Jupiter, these four planets constituting the "tidal planets." Relationships between planetary tides on the Sun and number of sunspots are discussed, and data for sunspot cycle peak dates in comparison with dates of peak planetary tidal fluctuations are tabulated back to the year 1604, together with estimated forward data to the year 2104. (UK)

Galaxies

5921 (AD–740848) OBSERVATIONS OF GALACTIC INFRARED SOURCES. Data Report No. 1 on Flight 2. Harwit, M. O.; Houck, J. R.; Pipher, J. L.; Soifer, B. T. (Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research). 1 Nov 1971. Contract F19628-70-C-0128. 25p. (AFCRL–71-591). NTIS.

The report consists of two parts and represents two scientific papers which present the results obtained in the July 16, 1971 flight of the Aerobee 170 rocket. The reports are titled "Rocket Infrared 4-Color Photometry of the Galaxy's Central Regions," and "Why Many Infrared Astronomical Sources Emit at 100 micrometers." (auth) (GRA)

5922 (NP–19474) SUPERCONDUCTING STRAIN TRANSDUCER FOR GRAVITATIONAL RADIATION EXPERIMENTS. Internal Note No. 373. Cerdonio, M.; Lucano, G. (Rome Univ. (Italy). Istituto di Fisica). 3 May 1972. 12p. Dep. NTIS (U. S. Sales Only).

The feasibility of a strain transducer based on combined cryogenic techniques which could be used as a strain detector in a liquid helium cooled gravitational wave antenna is proposed and discussed. The calculated sensitivity is significantly larger than that of Weber's antenna. In order to give a full evaluation of the minimum detectable signal, experiments are needed on the low frequency properties of ferromagnetic materials at liquid helium temperature. (auth)

5923 CH AND CH^+ FORMATION IN ION–MOLECULE REACTIONS. Stecher, T. P.; Williams, D. A. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J.; 177: No. 3, L141-4(1 Nov 1972).

The ion–molecule reactions between C^+ and H_2, which are normally endothermic, become exothermic and proceed with high rates when vibrational energy in H_2 exceeds the endothermicity. Excitation by ultraviolet photons in the Lyman and Werner bands leaves H_2 excited vibrationally. Vibrational relaxation is slow. It is suggested that CH^+ and CH can be produced by these ion–molecule reactions in about the amounts that are observed in the interstellar medium. (auth)

5924 VARIABILITY OF EXTRAGALACTIC SOURCES AT 10 MICRONS. Rieke, G. H. (Univ. of Arizona, Tucson); Low, F. J. Astrophys. J.; 177: No. 3, L115-19(1 Nov 1972).

Variations were detected at 10 μ in the fluxes from NGC 1068, NGC 4151, and 3C 273. The observations virtually eliminate the possibility that the infrared fluxes from these objects are generated thermally. (auth)

5925 RADIATIVE-LIFETIME STUDIES OF THE EMISSION CONTINUA OF THE HYDROGEN AND DEUTERIUM MOLECULES. Smith, W. H.; Chevalier, Roger (Princeton Univ. Observatory, N. J.). Astrophys. J.; 177: No. 3, 835-9(1 Nov 1972).

Radiative lifetimes were measured for states of the hydrogen and deuterium molecules that give rise to continua in the 1400 to 3500 Å region. The lifetimes of the $a^3\Sigma_g^+$ state are given as a function of the vibrational quantum number of the upper state. The second state observed is the $B^1\Sigma_u^+$ state which has appreciable transition probability into the vibrational continuum of the ground state. In both cases, the results are compared with the theoretical and experimental results available in the literature. The application of these results to the destruction of the hydrogen and the CH molecules in the interstellar medium is discussed. (auth)

5926 KINEMATICS OF PLANETARY NEBULAE IN THE LARGE MAGELLANIC CLOUD. Smith, M. G. (Cerro Tololo Inter-American Observatory, La Serena, Chile); Weedman, D. W. Astrophys. J.; 177: No. 3, 595-600(1 Nov 1972).

Radial velocities of 27 planetary nebulae in the Large Magellanic Cloud were measured with a pressure-scanned, Fabry–Perot interferometer. The results were combined with data from previous observers, and it was found that the planetary nebulae have a velocity dispersion perpendicular to the plane of the LMC which is twice the dispersion of the H II regions, but the systemic velocity of the planetaries agrees with that of the H II regions. This confirms previous suggestions that the LMC is a flattened, collapsed galaxy. (auth)

5927 GAMMA-RAY PRODUCTION FROM PROTON–PROTON REACTIONS IN THE GALACTIC DISK. Levy, D. J.; Goldsmith, D. W. (Univ. of California, Berkeley). Astrophys. J.; 177: No. 3, 643-6(1 Nov 1972).

Recent accelerator data was used to calculate the production rate of γ rays from $p + p \rightarrow p + p + n\pi^\circ$ reactions, which produce γ radiation by pion decay. The calculated γ-ray spectrum had a shape and peak value similar to the results found by Cavallo and Gould, but the spectrum was considerably broader than that calculated by Stecker. Because the γ-ray spectrum was somewhat wider than Cavallo and Gould's, the total γ-ray production rate of 3.2×10^{-26} γ-rays s^{-1} n_H^{-1} (for $E_\gamma > 100$ MeV) exceeded the results of Cavallo and Gould by 55% and those of Stecker by a factor of 3.5. The reasons for the discrepancy with previous calculations is discussed. (W.D.M.)

5928 INFALL OF MATTER INTO GALAXIES. de Vaucouleurs, G. (Univ. of Texas, Austin). Nature (London) Phys. Sci.; 239: No. 96, 139(30 Oct 1972).

The concept that infall of matter into galaxies from their coronae or from intergalactic space may play an important role in the structure and evolution of galaxies and their nuclei is discussed, and a resumé is given of the author's paper presented in 1963 at the Canberra–Sydney symposium on the Galaxy and the Magellanic Clouds. The author considers that the time has come to consider systematically the various possible interactions between galaxies and intergalactic matter. (UK)

5929 EFFECTS OF EVOLUTION ON THE DIAMETER–REDSHIFT RELATION. Tinsley, B. M. (Univ. of Texas, Dallas). Astrophys. J.; 178: No. 1, L39-42(15 Nov 1972).

The relation between redshift and metric angular diameters is unaffected by evolution of the light of galaxies, but the relation using isophotal diameters is subject to an evolutionary correction. At small redshifts, the required correction to the indicated value of q_0 is identical to that required in use of the magnitude–redshift relation. An apparent discrepancy, approximately equal to that found between Sandage's preliminary value ($q_0 \sim 1$) from isophotal diameters and Baum's value ($q_0 = 0.3$) from metric diameters, is predicted. (auth)

5930 NGC 2992 AND THE BLUE STELLAR OBJECT WEEDMAN NO. 2. Burbidge, E. M. (Univ. of California, San Diego); Strittmatter, P. A.; Smith, H. E.; Spinrad, H. Astrophys. J.; 178: No. 1, L43-6(15 Nov 1972).

Observations of the possible triple system consisting of NGC 2992, NGC 2993, and the blue stellar object Weedman 2 are reported. It is shown that, although Weedman 2 has no detectable emission lines, its continuous energy distribution is similar to those found in quasi-stellar objects. A luminous bridge extends from NGC 2992 toward Weedman 2, and the possibility that this could be due to excitation by Weedman 2 is discussed. Both galaxies have strong emission-line spectra. The system may provide further evidence for the association of QSOs with bright galaxies. Alternatively, tidal interaction may be responsible for the excitation in the galaxies and the luminous extension; the close proximity of Weedman 2 would then have to be ascribed to chance. (auth)

5931 RADIO EMISSION AND THE NUCLEI OF SPIRAL GALAXIES. Tovmasyan, G. M. (National Radio Astronomy Observatory, Green Bank, WV). Astrophys. J.; 178: No. 1, L47-9(15 Nov 1972).

It is shown that radio emission occurs mainly in galaxies that have starlike nuclei or other evidences of nuclear structure. (auth)

Cosmology

Refer also to abstract 6210.

5932 IRROTATIONAL BIANCHI-TYPE UNIVERSES IN THE BRANS–DICKE COSMOLOGY. Nariai, Hidekazu (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 2, 703-5(Aug 1972).

It is verified that, in spite of the coupling characteristic in Brans–Dicke cosmology between the substratum and the inertial mode, no irrotational Bianchi-type universe whose substratum is specified by $1 \geq p/\rho = \text{const} \geq 0$ can be free from the initial singularity of infinite density, on account of an inevitable temporal variation of H (in the Bianchi-type III, VI, VIII, and IX universes) and the required condition $\omega \leq -4/3$ (in the Bianchi-type I, II, IV, and V universes) contradicting the requirement $\omega \gtrsim 6$. (auth)

5933 CONSERVATION LAWS AND PREFERRED FRAMES IN RELATIVISTIC GRAVITY. II. EXPERIMENTAL EVIDENCE TO RULE OUT PREFERRED-FRAME THEORIES OF GRAVITY. Nordtvedt, K. Jr. (Montana State Univ., Bozeman); Will, C. M. Astrophys. J.; 177: No. 3, 775-92(1 Nov 1972).

Some metric theories of gravity single out the mean rest-frame of the Universe as a "preferred frame." They include theories devised by Page and Tupper, Yilmaz, Papapetrou, Ni, Coleman, and Rosen, as well as a vector-metric theory studied in Paper I of this series. These theories would satisfy the "three classical tests" of general relativity, if the solar system were at rest in the "preferred frame." But instead it probably moves with a speed of ~ 200 km s^{-1}. The new version of the Parametrized Post-Newtonian (PPN) formalism discussed in Paper I is used to show that such motion may produce (1) an anomalous 12-hour sidereal tide of the solid Earth; (2) an anomalous yearly variation in the Earth's rotation rate; (3) an anomalous perihelion shift of the planets. Gravimeter data, length-of-day data, and perihelion-shift data is used to put upper limits on the sizes of such anomalous effects. These limits rule out all the "preferred-frame" theories whose authors are listed above, and put an upper limit on the strength of a cosmological vector gravitational field. Other possible experimental tests of "preferred-frame" theories are discussed. (auth)

5934 CONSERVATION LAWS AND PREFERRED FRAMES IN RELATIVISTIC GRAVITY. I. PREFERRED-FRAME THEORIES AND AN EXTENDED PPN FORMALISM. Will, C. M. (California Inst. of Tech., Pasadena); Nordtvedt, K. Jr. Astrophys. J.; 177: No. 3, 757-74(1 Nov 1972).

A revised version of the Parametrized Post-Newtonian (PPN) Formalism is presented. By regrouping the old PPN parameters, a new set of parameters are obtained which are used to classify theories of gravity according to four attributes: curvature of space-geometry, nonlinearity of gravity, existence of a preferred universal rest-frame, and validity of conservation laws for momentum. A variety of preferred-frame theories of gravity are studied, and it is shown that new terms must be added to the PPN metric in order to analyze such preferred-frame theories from any chosen frame of reference. These new terms depend on the velocity of the observer's chosen frame relative to the preferred universal rest-frame singled out by such theories. (auth)

5935 OBSERVATIONS OF THE SOFT X-RAY BACKGROUND. Davidsen, A.; Shulman, S.; Fritz, G.; (and others) (Naval Research Lab., Washington, D. C.). Astrophys. J.; 177: No. 3, 629-42(1 Nov 1972).

Observations of the diffuse x-ray background over a hemisphere of the sky in the galactic anticenter direction provide clear evidence for an excess intensity below 1 keV in all directions. The correlation of this low-energy flux with galactic latitude and with hydrogen column density implies that the radiation originates partially within and partially outside the absorbing layers of the Galaxy. The data are consistent with a model combining an isotropic extragalactic flux with a component due to emitters distributed in the same way as the galactic hydrogen. The mean absorption coefficient of the interstellar medium for photons near 0.28 keV agrees with the theoretically expected value for a uniform absorbing medium and a normal He/H abundance ratio. If discrete sources are responsible for the intensity observed near the galactic plane, then a high density of low-luminosity objects is consistent with the data. (auth)

5936 COMMENT ON INVERSE COMPTON MODELS FOR THE ISOTROPIC X-RAY BACKGROUND AND POSSIBLE THERMAL EMISSION FROM A HOT INTERGALACTIC GAS. Cowsik, R.; Kobetich, E. J. (Univ. of California, Berkeley). Astrophys. J.; 177: No. 3, 585-93(1 Nov 1972).

The spectrum of the isotropic x-ray background was calculated under the assumption that it arises through Compton scattering of the universal microwave photons by relativistic electrons leaking out of the galaxies. The elegant fit to the experimental data obtained by earlier authors who made many approximations in their calculations disappears in the more detailed treatment. Inverse Compton models for the origin of background x rays are therefore not adequate to explain all the spectral features in detail. In particular, there is evidence for a thermal component in the x-ray background arising possibly from a hot intergalactic gas at $\sim 3 \times 10^8$°K. (auth)

5937 OPERATIONAL DETERMINATION OF SCHWARZSCHILD COORDINATES. Banerji, S. (Inst. for Advanced Studies, Dublin). Nature (London) Phys. Sci.; 239: No. 96, 141-2(30 Oct 1972).

Newtonian theory involves the concept of rigid rods in the measurement of distance and also the concept of absolute time; but these have no existence in the Einstein theory of gravitation, and the question arises as to how mathematical coordinate systems are to be identified with physically realizable frames of reference. In the present communication consideration is given to the exterior gravitational field of a spherical nonrotating star in the form given by Schwarzschild, in the context of the operational determination of Schwarzchild coordinates. (UK)

5938 COMPUTER ANALYSES OF GRAVITATIONAL RADIATION DETECTOR COINCIDENCES. Weber, J. (Univ. of Maryland, College Park). Nature (London); 240: No. 5375, 28-30 (3 Nov 1972).

Reference is made to an antenna system developed by the author (see Phys. Rev. 117: 306 (1960)) to detect gravitational radiation. The antennas are isolated from the local environment by acoustic and electromagnetic shielding, but they do respond to sufficiently large local disturbances; these effects can, however, be minimized if two detectors are used that are a considerable distance apart. Coincidence experiments at 1661 Hz, carried out with two antennas, one situated at the University of Maryland and the other at the Argonne National Laboratory 1000 km distant, are described. Coincidences may be due to excitation of both detectors by a common source or to chance, and it is customary to compute the chance coincidence rate by formulating a classification scheme for the coincidences and computing the number of chance coincidences in each class. Details are given of the experimental and computational techniques employed. Use of a magnetic tape and a computer provided a procedure for data processing. Before it can be concluded from the data that the source is gravitational radiation it is essential to rule out seismic, electromagnetic, and cosmic-ray effects, and means for doing this are described. It is considered established beyond reasonable doubt that the gravitational radiation detectors, at the ends of a 1000 km baseline, are being excited by a common source as a result of interactions that are neither seismic, electromagnetic, nor due to cosmic rays. (UK)

5939 MODEL OF A GRAVITATING SPHERE SET IN ROTATION BY INTERNAL STRESS. Hogan, P. A.; Synge, J. L. (Dublin Inst. for Advanced Studies). Gen. Relativity Gravitation; 3: No. 3, 269-80(Oct 1972).

The systematic approximation technique of Synge is employed to construct a model of a spherical body at rest in the distant past and gradually attaining an angular velocity due to a modification of the internal stress. The calculations are carried out to include the second approximation so that, roughly speaking, there is an error of order m^3 in Einstein's field equations where m is the mass of the sphere. (auth)

5940 COSMOLOGY, FUSION, AND OTHER MATTERS. George Gamow Memorial Volume. Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972). 330p. $15.00.

Separate abstracts were prepared for 13 of the included papers. (M.O.W.)

For abstracts of individual papers see: 5835, 5857, 5919, 5941–5948, 6635, and 6726.

5941 REFLECTIONS ON "BIG BANG" COSMOLOGY. Alpher, R. A. (General Electric Co., Schenectady, N. Y.); Herman, R. pp 1-14 of Cosmology, Fusion, And Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

The development of studies on nucleosynthesis; the integration of these ideas into the big-bang model; consequences with respect to the structure and evolution of the Universe; residual cosmic blackbody radiation; and cosmonumerology are briefly sketched. (W.D.M.)

5942 CONFORMAL INVARIANCE IN PHYSICS AND COSMOLOGY. Hoyle, F.; Narlikar, J. V. (Cambridge Univ., Eng.). pp 15-28 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

The significance of conformal transformation is discussed in relation to physical theories and cosmology. The role of cosmological boundary conditions is also considered. (W.D.M.)

5943 COSMOLOGY AND MICROWAVE ASTRONOMY. Penzias, Arno A. (Bell Telephone Labs., Holmdel, N. J.). pp 29-47 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

Topics discussed include discovery of the microwave background, spectrum of the microwave background, isotropy, and mass density of the Universe. (W.D.M.)

5944 MODEL OF THE EXPANDING UNIVERSE. Wataghin, G. (Univ., Turin). pp 48-55 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

Starting from the Gamov idea that at some early epoch of the evolution of the expanding Universe the average temperature of the three-dimensional subspace X_4 = constant of the Friedmann model must have been extremely high, a simple solution of the Einstein equations is discussed based on the assumption that the uniform cosmological evolution can be described approximately as being dominated by particles of vanishing mass filling the Universe. These particles at the early epoch are the extreme relativistic particles and photons and neutrinos. From some subsequent epoch they are neutrinos and probably gravitons. (W.D.M.)

5945 VARIABILITY OF THE GRAVITATIONAL CONSTANT. Dirac, P. A. M. (Florida State Univ., Tallahassee). pp 56-9 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

The gravitational force between two masses involves the parameter γ which is usually considered to be a universal constant. However, with an expanding model of the Universe, there is a possibility that γ is not constant, but varies with the time since the start of the expansion. This possibility is briefly discussed. (W.D.M.)

5946 ARE THE CONSTANTS CONSTANT? Teller, E. (Univ. of California, Berkeley). pp 60-6 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

The possibility that the constant of gravitation may be changing with time is discussed in some detail with arguments for and against presented. Variation of the fine structure constant is also considered. (W.D.M.)

5947 NEW OBSERVATIONS AND OLD NUCLEOCOSMOCHRONOLOGIES. Fowler, W. A. (California Inst. of Tech., Pasadena). pp 67-123 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

Topics considered in some detail include models of nucleocosmochronology, old models and the new results, models incorporating events of sudden synthesis, astrophysical implications of nucleosynthesis in stars, abundance and production ratios, calculation of model parameters and uncertainties, and mass 187 and 87 chronologies. (W.D.M.)

5948 NEUTRINO PHYSICS: PROSPECTS. Cowan, C. L. (Catholic Univ. of America, Washington, D. C.); Reines, F. pp 150-68 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

The field of neutrino physics is considered in terms of the various sources which have been used for experiments: fission reactors; accelerators; high-energy cosmic rays; solar neutrinos; and double beta decay. (W.D.M.)

5949 FAR-INFRARED AND SUBMILLIMETER BACKGROUND. Houck, J. R. (Cornell Univ., Ithaca, NY); Soifer, B. T.; Harwit, Martin; Pipher, J. L. Astrophys. J.; 178: No. 1, L29-33(15 Nov 1972).

Earlier observations of the infrared and submillimeter background radiation were repeated. While the measured values of the infrared background radiation remain unchanged, the high flux previously reported for the 0.4 to 1.3 mm range was not observed. This indicated that the flux could not have been galactic or cosmic, but further observations are needed to rule out a solar-cycle-dependent geocoronal origin. (auth)

5950 POSSIBLE SIDEREAL PERIOD FOR THE SEISMIC LUNAR ACTIVITY. Sadeh, D. (Tel Aviv Univ., Israel). Nature (London); 240: No. 5377, 139-40(17 Nov 1972).

It was found that maximum lunar seismic activity corresponds to the rise of the pulsar CP 1133. (auth)

5951 CLOSED TIME AS AN EXPLANATION OF THE BLACK BODY BACKGROUND RADIATION. Davies, P. C. W. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Nature (London) Phys. Sci.; 240: No. 97, 3-5(6 Nov 1972).

3°K isotropic blackbody radiation is explained in terms of the accumulated starlight from a subsequent time reversed cycle of the Universe, thermalized in the adjoining dense state. (auth)

Planetary Phenomena

Refer also to abstract 5828.

5952 DEPTH PROFILE OF ^{14}C IN THE LUNAR ROCK 12 002. Boeckl, R. S. (Univ. of California, San Diego, La Jolla). Earth Planet. Sci. Lett.; 16: No. 2, 269-72(Oct 1972).

A depth profile of ^{14}C in lunar rock 12002 was measured using six specimens with well-defined depth below the exposed surface of the rock. The results obtained showed an excess surface activity attributed to solar particle flux. (auth)

5953 TRACE ELEMENT PROFILES, NOTABLY Hg, FROM A PRELIMINARY STUDY OF THE APOLLO 15 DEEP-DRILL CORE. Jovanovic, S.; Reed, G. W. Jr. (Argonne National Lab., Ill.). Earth Planet. Sci. Lett.; 16: No. 2, 257-62(Oct 1972).

Previously reported results on Hg in Apollo 11, 12, and 14 and Luna 16 core and trench samples are interpreted in terms of the diurnal thermal pulse and layering processes. Apollo 15 deep-drill core samples from greater depths would not be expected to and do not respond to diurnal heating but the (labile) Hg profile reflects a layering process with little or no mixing and is in agreement with the extent of surface exposure that might be predicted on the basis of track studies by Phakey et al. Concentrations of Os, Ru, and U in the deep-drill core samples are also reported. (auth)

5954 GEOMETRY AND DYNAMIC SPECTRA OF Io-MODULATED JOVIAN DECAMETRIC RADIO EMISSIONS. Smith, R. A. (Univ. of Maryland, College Park); Wu, C. S.; Zmuidzinas, J. S. Astrophys. J.; 177: No. 3, L131-6(1 Nov 1972).

An explanation of the asymmetry of Io's ephemeris positions for the early and main source emissions is given. The asymmetry is attributed to a time lag caused by the small group velocity which controls the propagation of the radiation inside the Jovian magnetosphere. As observed, the radiation has propagated through a rotating medium. The overall propagation characteristics determine the sense of frequency drift of the individual sources. (auth)

5955 REFRIGERATION OF LUNAR SAMPLES DESTINED FOR THERMOLUMINESCENCE STUDIES. Durrani, S. A. (Univ. of Birmingham, Eng.). Nature (London); 240: No. 5376, 96-7(10 Nov 1972).

It is stated that the need for low-temperature storage of lunar samples intended for thermoluminescence investigation does not seem to be generally appreciated, with the result that a good deal of useful information is irretrievably lost. The same applies to freshly fallen meteorites. Quantitative data supporting this contention are given. The main purposes of TL investigations of such material are discussed, including the derivation of the radiation and temperature histories of the samples and estimation of cosmic-ray exposure and age of the samples or their parent bodies. For peaks which are observed at relatively low readout temperatures (say ~150°C) half lives at room temperature are often quite short, of the order of a few days or weeks, and thus low-temperature storage as well as prompt distribution of samples for TL studies is called for. The loss of low-temperature peaks is particularly unfortunate in the case of lunar core tube samples which, having been at low ambient temperature on the Moon, should have displayed substantial TL in the first natural peaks had fading been arrested by placing them in laboratory deep freeze. The advantages of refrigeration were demonstrated for the Allende meteorite that fell in February 1969. Some data are given for Apollo samples. Storage of samples under refrigeration in museums and laboratories is strongly recommended, and prompt distribution of samples intended for TL studies is urged. (UK)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 5836.

5956 (AD–740814) CORRELATION OF RADAR ECHOES FROM THE AURORA WITH SATELLITE-MEASURED AURORAL PARTICLE PRECIPITATION. Final Report, March 1969–December 1971. Chesnut, W. G.; Hodges, J. C.; Leadabrand, R. L. (Stanford Research Inst., Menlo Park, Calif.). Dec 1971. Contract DASA01-67-C-0066. 157p. (DNA–2825-F). NTIS.

The characteristics of auroral particle precipitation as measured during 14 passes by the Lockheed OVI-18 satellite over Alaska are compared with radar aurora simultaneously detected at 139 and 398 MHz beneath the satellite orbit. The radar aurora were measured using the SRI auroral radar located at Homer in southern Alaska. The satellite measured precipitation of protons with energies above 10 keV and precipitation of electrons with energies above 800 eV. All measurements were made near local midnight while the E region was in darkness. (auth) (GRA)

5957 (AD–741757) AFCRL SPACE SCIENCE RESEARCH DURING 1971 (ANNUAL AFCRL REPORT TO THE SPACE SCIENCE BOARD OF THE NATIONAL ACADEMY OF SCIENCES FOR SUBMISSION TO COSPAR). Special Reports No. 130, January 1–December 31, 1971. McIntyre, A.; Howard, C. D. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 17 Jan 1972. 40p. (AFCRL–72-56). NTIS.

A summary of the space science activities of the Air Force Cambridge Research Laboratories (AFCRL) in 1971, including rockets, satellites, and balloons launched, results of experiments associated with the measurement and study of energetic particles and magnetic fields, upper atmosphere physics, ionospheric physics, geodesy, and optical physics, and experiments planned for 1972, are included. The definition of space science for the purpose of this report is limited to in-situ observations and measurements using the broad definition of space. (auth) (GRA)

5958 (AD–742258) IMPROVEMENTS IN IONOSPHERIC FORECASTING CAPABILITY. Rush, C. M. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 28 Feb 1972. 65p. (AFCRL-ERP–387; AFCRL–72-138). NTIS.

The results of a study undertaken to determine the feasibility of employing synoptic mapping to improve ionospheric forecasting capabilities are presented. Using electron-density data obtained from 16 ionosonde stations located in North America and Greenland during the time period mid-April through July 1970, the temporal and spatial variability of the ionosphere was assessed. (auth) (GRA)

5959 (AD–745204) HIGH LATITUDE IONOSPHERIC IRREGULARITIES OBSERVED BY MEANS OF SATELLITE BEACONS AND ROCKET PROBES. Final Scientific Report, November 1, 1969–December 31, 1971. Bratteng, O. M.; Frihagen, J. (Auroral Observatory, Tromso (Norway). Forsvarets Forskningsinstitutt, Kjeller (Norway)). 20 Mar 1972. Contract F61052-70-C-0002. 21p. (AFCRL–72-328). NTIS.

Numerous height measurements of ionospheric irregularities have shown them to be located in the regions 300 to 600 km above the ground. Observations are presented that show that there is no appreciable reduction in scintillation at 136 MHz when a satellite loses height from in excess of 1000 km to less than 300 km. (auth) (GRA)

5960 (AD–745325) SEASONAL, DIURNAL, AND MAGNETIC DEPENDENCE OF IONOSPHERIC TOTAL ELECTRON CONTENT AT 63 DEGREES INVARIANT LATITUDE. Final Report, March 1, 1969–October 31, 1971. Mikkelsen, I. S. (Danish Meteorological Inst., Copenhagen. Geophysical Section). Apr 1972. Contract F61052-69-C-0019. 13p. (AFCRL–72-365). NTIS.

The total ionospheric electron content at 63° invariant latitude shows a strong seasonal dependence. The diurnal variation is smallest during summer, whereas the winter months show the highest day values as well as the lowest night values. Next, the electron content shows a 27-day cycle, which is well correlated with the variations of the solar flux in the cm band. The night values of the summer data show a marked tendency to decrease with increasing Kp values. (auth) (GRA)

5961 (WRE-TM–560(WR and D)) STUDY OF THE FEASIBILITY OF MEASURING D-REGION ELECTRON DENSITIES USING A 3.5 INCH W.R.E. SOUNDING ROCKET (KOOKABURRA). Bowers, B. C. (Weapons Research Establishment, Salisbury (Australia)). Apr 1972. 13p. Dep. NTIS (U. S. Sales Only).

The technique of using Faraday rotation to measure electron densities is described. Some of the problems associated with the method are considered, with particular regard to the limitations imposed by currently available sounding rockets. A future program of experiments that coordinates ionospheric data with that of other data collected by Upper Atmosphere Research Group (W.R.E.) is proposed. (auth)

5962 AUTOMATIC N(h,t) PROFILES OF THE IONOSPHERE WITH A DIGITAL IONOSONDE. Wright, J. W. (National Oceanic and Atmospheric Administration, Boulder, Colo.); Laird, A. R.; Obitts, D.; Violette, E. J.; McKinnis, D. Radio Sci.; 7: No. 11, 1033-43(Nov 1972).

A method is described to accomplish automatic data selection and profile inversion to obtain ionospheric electron-density profiles from digitized radio soundings. The profile inversion is based upon the well-established formulation of Paul [1960] by which the optimum radio-frequency sounding intervals can be specified from an approximate knowledge of the profile. The expected virtual height coordinates (h′) at these frequencies (f) are likewise estimated, and procedures are then used to select h′(f) observations nearest the predicted coordinates from a subsequent digital ionogram. From these the next profile is obtained. The process adaptively follows the changing shape and detail of the profile. The procedure requires an average of 20 sec per profile on a standard data-processing computer and can be adapted, with benefit to on-line real-time use in our "dynasonde," digital ionosonde. (auth)

5963 IMPROVED TRUE-HEIGHT REDUCTION TECHNIQUE. Kantarizis, E.; Whitehead, J. D. (Univ. of Queensland, Brisbane). Radio Sci.; 7: No. 11, 1045-8(Nov 1972).

The advent of the phase ionosonde, which gives more precise experimental data than the conventional instrument, has made it necessary to seek improvement in the technique of true-height reduction by reducing calculation errors. The method described here gives errors of approximately a few meters when the lowest observable frequency is 0.6 MHz and both magnetoionic modes are used. (auth)

5964 RADAR MEASUREMENT OF IONOSPHERE MOTION IN THE PRESENCE OF CURRENT-INDUCED SPECTRAL ASYMMETRIES. Rino, C. L. (Stanford Research Inst., Menlo Park, Calif.). Radio Sci.; 7: No. 11, 1049-60(Nov 1972).

The technique of measuring ionosphere motion from the shift in the incoherent-scatter ion line has been known for some time. The underlying assumption in the adaptations of the technique applied so far is that there are no detectable current-induced asymmetries in the spectrum. In the auroral zone this assumption can be violated during magnetospheric storms. An estimate of the first moment of the spectrum together with a matched-filter-like estimate is used. The first moment is the sum of the first moment of the unshifted spectrum plus the Doppler shift. The matched-filter estimate, while not unaffected by asymmetries, tends to give an estimate closer to the Doppler shift. Hence, a difference between the two estimates is an indication of a current flowing in the range gate where the spectrum is measured. It is assumed that no other sources of asymmetry are present, although a large temperature gradient would have a similar effect. In principle, the difference can be calibrated to give the magnitude of the current. This step is not yet completed owing to uncertainties in the composition of the ionosphere at low altitudes and a loss of frequency resolution due to the finite pulse length. The detectability of the currents by this method, however, is not affected by poor frequency resolution. Preliminary results from the Chatanika Auroral-Zone Incoherent-Scatter Radar are presented that show large velocities correlated in detail with simultaneous magnetometer data. Also an indication of a current flow was observed in premidnight data taken on a very active night. An azimuth scan showed the sense of the current to be predominantly westward. (auth)

5965 D-REGION ELECTRON HEATING BY A LOW-FREQUENCY TERRESTRIAL LINE CURRENT WITH GROUND RETURN. Row, R. V. (Symbionics, Waltham, MA.); Mentzoni, M. H. Radio Sci.; 7: No. 11, 1061-6(Nov 1972).

A horizontal current-carrying wire near the surface of the

Earth will maintain a tangential electric field in the ionosphere overhead. The question of how large this field must be to produce a given local increase in electron temperature in the D region and the corresponding required current (dipole moment) in the wire are addressed here. To achieve a 20 K modulation (about 10% of ambient temperature) of the local electron temperature at an altitude of 70 km under daytime conditions would require an rms current of 2730 amp at 45 Hz over a length of at least 300 km where the ground conductivity is 1.4×10^{-4} mho m^{-1}. A parallel array of 23 wires spaced at 10-km intervals will produce the same temperature modulation with only 139 amp in each wire. (auth)

5966 LOW ENERGY ATMOSPHERIC GAMMA RAYS NEAR GEOMAGNETIC EQUATOR. Kasturirangan, K.; Rao, U. R.; Bhavsar, P. D. (Physical Research Lab., Ahmedabad, India). Planet. Space Sci.; 20: No. 11, 1961-77(Nov 1972).

Based on the results from three balloon flights, made at Hyderabad (7.6°N geomagnetic latitude) using omnidirectional gamma-ray spectrometers, the different aspects of the low-energy atmospheric gamma rays at equatorial latitudes in the energy interval 100 keV to 1 MeV are investigated and detailed discussion is presented. The energy loss spectrum in this energy range is found to consist of a continuum superimposed on which is a photopeak due to the 0.51-MeV line arising from electron–positron annihilation. The continuous background spectrum is similar to that observed at middle and high latitudes. The intensity of the 0.51-MeV line is estimated to be 0.079 ± 0.01 photons cm^{-2} at 6 g cm^{-2} over Hyderabad and the altitude dependence of its intensity is established for this low-latitude station. The latitude effect of the intensity of this line at 6 g cm^{-2} is derived for the first time by comparing the results of the present measurements with those available for middle and high latitudes. The contribution of the cosmic gamma rays to the observed count rates at 6 g cm^{-2} is shown to be negligible in the case of the omnidirectional spectrometers of the type used in the present observations, even for low-latitude stations. (auth)

5967 ATMOSPHERIC GRAVITY WAVES TO BE EXPECTED FROM THE SOLAR ECLIPSE OF JUNE 30, 1973. Beer, T.; May, A. N. (Ghana Univ., Legon). Nature (London); 240: No. 5375, 30-2(3 Nov 1972).

It has been pointed out that the Moon's shadow on the Earth's atmosphere during a solar eclipse constitutes a cooling region traveling at supersonic speed that may be expected to generate a bow wave with a magnitude of about 10^{-5} atmosphere at ground level and 10^{-1} of ambient pressure at 200 km altitude, and give rise to gravity waves. These effects are considered in relation to the solar eclipse of June 30, 1973. There is also a possibility that the daily heating and cooling at sunrise and sunset could give rise to effects of this kind, and may produce a continuous spectrum of gravity waves, as well as providing an important source for the gravity waves observed in the ionosphere under normal conditions. (UK)

5968 ENERGY SPECTRA IN RELATIVISTIC ELECTRON PRECIPITATION EVENTS. Rosenberg, T. J.; Lanzerotti, L. J.; Bailey, D. K.; Pierson, J. D. (Univ. of Maryland, College Park). J. Atmos. Terrest. Phys.; 34: No. 12, 1977-90(Dec 1972).

Two events in August 1967, categorized as relativistic electron precipitation (REP) events by their effect on vhf transmissions propagated via the forward-scatter mode, were examined with regard to the energy spectra of trapped and precipitated electrons. These two substorm-associated events (August 11 and August 25) differ with respect to the relativistic, trapped-electron population at synchronous altitude; in the August 25 event there was a non-adiabatic enhancement of relativistic (>400 keV) electrons while in the August 11 event no relativistic electrons were produced. In both events electron spectra deduced from bremsstrahlung measurements (made on a field line close to that of the satellite) had approximately the same e-folding energies as the trapped electron enhancements. However, the spectrum of electrons in the August 25 event (E_0 = 100 to 150 keV) was significantly harder than the spectrum in the event of August 11 (E_0 = 40 to 70 keV). The spectrum of precipitated electrons deduced from the ratio of vhf forward-scatter absorption to riometer absorption can be made consistent with the spectrum deduced from the bremsstrahlung measurements if the normal summer daytime scattering height for vhf propagation is assumed to lie between 70 and 75 km. However, in the absence of an independent determination of the scattering height, the spectrum of the precipitating electrons can not be deduced from these vhf measurements alone. (auth)

5969 FOCUSING OF RADIO WAVES FROM E_s -IRREGULARITIES. Srivastava, S. K.; Pradhan, S. M.; Tantry, B. A. P. (Banaras Hindu Univ., India). J. Atmos. Terrest. Phys.; 34: No. 12, 1991-8(Dec 1972).

Experimental evidence is presented to show that, under suitable conditions, E_s patches of ionization could perceptibly influence the amplitude and phase path of the radio waves reflected vertically from the F region. It is argued that simultaneous measurements of amplitude and phase path such as those reported here, would allow inferences to be drawn regarding some of the characteristics of the E_s layer. Rough estimates of the enhanced electron density in the E_s patches, their horizontal extent, and their velocities have been made and are found to be in reasonable agreement with those reported by other workers employing different techniques. (auth)

5970 SOME RESULTS OF ABSORPTION MEASUREMENTS AT A LOW LATITUDE STATION. Ganguly, S. (Bose Research Inst., Calcutta). J. Atmos. Terrest. Phys.; 34: No. 12, 2009-23 (Dec 1972).

Some major results of a series of extensive measurements of A_1 absorption on eight different frequencies ranging from 1.7 to 6.5 MHz made at Calcutta during the period 1966 to 1968 are presented. The data have been utilized in determining the frequency exponent "m" both during normal and disturbed periods and also in separating the so-called nondeviative (B) component of absorption and E-region parameter (C). Both B and C values exhibit diurnal, seasonal, and solar-activity dependence. The zenith-angle dependence of "C" is in good agreement with observed height changes in the E region, whereas, the dependence of "C" on solar activity is possibly caused through an increase in atomic oxygen concentration with increasing solar activity. Attempts have also been made in comparing the observed variations in "B" values with those produced by the different models of production and loss processes in vogue. The comparison suggested, that the n (NO) model of Meira (1971) with the loss model of Meira (1971) with the loss model of Mitra (1970) is perhaps the best in explaining the observed findings. Although, in order to explain the solar-activity dependence of the B values, it was felt necessary that the ionization due to NO must increase by at least a factor of 1.5 from solar minimum to solar maximum, or a decrease in loss rate should occur. (auth)

5971 ATMOSPHERIC WAVE-INDUCED INSTABILITY IN THE NIGHTTIME E-REGION. Beer, T.; Moorcroft, D. R. (Univ. of Western Ontario, London). J. Atmos. Terrest. Phys.; 34: No. 12, 2025-43(Dec 1972).

The perturbed continuity equation, when the perturbations are the result of an internal atmospheric gravity wave in the E region, is examined. The transient response of the ionization is interpreted as the gradient instability, and the values of the vertical and horizontal wave numbers that will induce it are plotted for various heights. Only in the presence of westward-directed electric fields, which are believed to occur only at night, will the gravity waves induce the gradient instability. Approximate analytic expressions are obtained for the permitted wave numbers as well as for the instability growth times. In the course of this analysis it is shown that in the D region all irregularities, even those that are field-aligned, will tend to move with the ion velocity. (auth)

5972 NIGHTTIME SPORADIC E. Beer, T.; Moorcroft, D. R. (Univ. of Western Ontario, London). J. Atmos. Terrest. Phys.; 34: No. 12, 2045-57(Dec 1972).

At night, internal atmospheric gravity waves are able to induce drift instabilities in the ionospheric plasma. Nighttime constant-height-type sporadic E(E_{sc}) may then be explained as an effect due to the combined effect of ionization movement due to the wind-shear mechanism and due to the cross-field gradient drifts. This combined concept provides a qualitative explanation of the rocket observed nighttime electron-density profiles, of the speeds of the E_{sc} irregularities, and of the variations of E_{sc} with latitude and electric-field strength. (auth)

Magnetospheric Phenomena

Refer also to abstracts 5314, 5957, and 6717.

5973 (AD-741681) ELECTROSTATIC INSTABILITY OF RING CURRENT PROTONS BEYOND THE PLASMAPAUSE DURING INJECTION EVENTS. Coroniti, F. V.; Fredricks, R. W.; White, R. (California Univ., Los Angeles. Plasma Physics Group. TRW Systems Group, Redondo Beach, Calif.). May 1972. Contract N00014-69-A-0200-4023. 18p. (PPG-119). NTIS.

The stability of ring-current protons with an injection spectrum

modeled by an m = 2 mirror distribution function was examined for typical ring-current parameters. (auth) (GRA)

5974 (AD-741695) OBSERVATIONS OF CHARGED PARTICLE PRECIPITATION OVER THE AURORAL ZONE DURING A MAGNETIC SUBSTORM. Ackerson, K. L. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Mar 1972. Contract N00014-68-A-0196-0003. 52p. NTIS.

An array of sensitive electrostatic analyzers was launched on the satellite INJUN 5 into a nearly polar, low-altitude orbit. A series of three traversals of the northern auroral zone in the local evening sector on December 3, 1968 has provided high-energy and time-resolution observations of low-energy proton and electron intensities within the energy range 50 < or = E < or = 15,000 eV before, during, and after a polar magnetic substorm. The region of high intensities of plasmasheet electrons expanded dramatically during the substorm, extending about 3.5° farther poleward and about 4.5° farther equatorward relative to that of the preceding pass. (auth) (GRA)

5975 (AD-745563) RELATIONSHIP BETWEEN THE GROWTH AND EXPANSION PHASES OF SUBSTORMS AND MAGNETOSPHERIC CONVECTION. Mozer, F. S. (California Univ., Berkeley. Space Sciences Lab.). 5 Jul 1972. Contract N00014-69-A-0200-1015. 15p. NTIS.

It is suggested that the definition of the growth and expansion phases of substorms should rest on magnetospheric convection theories and data because of the ambiguities in interpretation of ground magnetometer records from which these concepts arose originally. Data such as that discussed in the report offers strong evidence for the validity and usefulness of the concepts of the growth and expansion phases. (auth) (GRA)

5976 MAGNETOSPHERIC FIELD FLUCTUATIONS AND THE PENETRATION OF SOLAR PROTONS TO LOW GEOMAGNETIC LATITUDE. Quenby, J. J. (Imperial Coll. of Science and Tech., London). Planet. Space Sci.; 20: No. 11, 1979-82 (Nov 1972).

Diffusive penetration of low-energy solar protons into magnetospheric L shells below the limit of stable particle trapping is considered. Violation of the third adiabatic invariant by a wave–particle interaction involving a resonance at a low multiple of the particle drift period is suggested as the main cause of the diffusion. Azimuthal electric fields or azimuthal magnetic-field gradients associated with very low frequency hydromagnetic waves bring about the motion in L. (auth)

5977 QUANTITATIVE MODEL OF THE GEOMAGNETIC TAIL. Willis, D. M.; Pratt, R. J. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys.; 34: No. 12, 1955-76 (Dec 1972).

A quantitative model of the geomagnetic tail is presented that is realistic to distances beyond the orbit of the Moon. In this model the sources of the magnetic field in the magnetosphere comprise: (i) a dipole, to represent the Earth's main magnetic field; (ii) a larger "image" dipole, to represent the induced shielding currents flowing in the magnetopause; and (iii) a set of contiguous current sheets of finite width and thickness, to represent the geomagnetic tail. The current density is assumed to be uniform in each current sheet but to vary from one sheet to another in such a way as to give a best fit to the satellite measurements of magnetic intensity in the tail. This model magnetosphere is examined in detail and it is shown that it provides a good representation of the geomagnetic field under quiet conditions. The component of magnetic field normal to the solar-magnetospheric equatorial plane is directed northward everywhere in the midnight meridian, but is directed southward in regions near the flanks of the magnetosphere. This reversal of the normal component is associated with the existence of neutral lines in the equatorial plane near the dawn and dusk boundaries of the tail. The model magnetopause diverges with distance down the tail out to about 65 Earth radii and cross sections beyond 20 R_E are elongated in a direction perpendicular to the equatorial plane, in agreement with some of the observations. (auth)

5978 EVIDENCE FOR STRONG PITCH-ANGLE DIFFUSION WITHIN THE POLAR CUSPS. Lehmann, H.-R.; Treumann, R. (Heinrich-Hertz-Institut fuer Schwingungsforschung, Berlin). Nature (London) Phys. Sci.; 239: No. 96, 143-6(30 Oct 1972).

It is stated that the tangential gradients of the magnetic field on the dayside magnetopause point in the direction of the polar neutral points, which are the sources and sinks of almost all the magnetic-field lines that make up the magnetopause, and the geometry of the magnetospheric field allows for lines of maximum gradient drift perpendicular to the magnetopause and connecting the neutral points along the line of demarcation with the neutral sheet of the tail. It is proposed that magnetosheath plasma enters the magnetosphere along these zones of maximum tangential gradient drift velocity, thereby identifying them with the polar cusps. Some of the characteristics of the observed particle population within the polar cusps can then be explained if it is further assumed that the inward drift motion of the particles couples to strong pitch-angle diffusion. This assumption is partially justified by the measured pitch-angle distributions in the distant polar cusps, which suggest that the distribution near the loss cone is more isotropic than in the magnetosheath. It is also natural to assume that the polar cusp region will be highly unstable against various kinds of plasma waves, and hence wave–particle interactions leading to pitch-angle diffusion could occur in that region. The work of Kennel (Rev. Geophys., 7: 379(1969)) in this field is discussed and modifications proposed. Conclusions reached are that low-energy particles do not drift as far into the magnetosphere as particles of higher energy and should, therefore, precipitate at higher dayside invariant latitudes on closed field lines; a latitude-dependent precipitation energy pattern is predicted, with lower-energy particle precipitation poleward of higher-energy-particle precipitation. Also, because of their greater mass, protons penetrate deeper into the dayside magnetosphere than electrons, and their precipitation belt should, therefore, be observed at lower invariant latitudes than for electrons. Also, because low-energy particles precipitate from greater Earth distances than higher-energy particles, the particle energy spectra should lose their low-energy component with deeper entrance into the polar cusps, and hence the distant polar cusp should act as an energy filter. The kind of wave-particle interaction that leads to the proposed strong diffusion within the polar cusps is briefly discussed. (UK)

5979 INTRINSIC BANDWIDTH OF CYCLOTRON RESONANCE IN THE GEOMAGNETIC FIELD. Schulz, Michael (Aerospace Corp., El Segundo, CA). Phys. Fluids; 15: No. 12, 2448-9(Dec 1972).

Equatorial resonance between electrons and very low-frequency signals is characterized by an intrinsic bandwidth ~20 Hz at L = 3, owing to the inhomogeneity of B. The corresponding interaction time (~50 msec) approximates the length of a Morse dot. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 5991.

5980 RELATIVE AUGER ELECTRON EMISSION INTENSITIES FROM LIGHT METALS BOMBARDED WITH IONS. Viaris de Lesegno, Patrick (Univ. Paris, Saint-Denis, France); Hennequin, Jean-Francois; Joyes, Pierre. Compt. Rend., Ser. B; 275: No. 2, 93-6(10 Jul 1972). (In French).

The Auger electron emission spectra obtained during the bombardment of lithium and sodium targets with 10-keV Ar^+ ions are presented and compared with those of other light metals. An interpretation of the relative intensities of Auger emission from these metals is proposed, which is based on the correlation diagrams describing the changes in the electron levels during the collision of two atoms inside the metal. (France)

5981 IONIZATION LOSSES IN SPECTRA OF INELASTIC ELECTRON REFLECTION FROM RARE EARTH METAL SURFACES. Tsveiman, E. V.; Zashkvara, V. V.; Korsunskii, M. I.; (and others) (Inst. of Nuclear Physics, Alma-Ata, USSR). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 5, 1333-5(Nov 1972).

Translated from Fiz. Tverd. Tela; 14: No. 5, 1549-51(May 1972).

The inelastic reflection electron spectra of La, Pr, Nd, Sm, Gd, Dy, Yb, and Hf were investigated in the energy-loss range 0 to 300 eV. The spectra for a primary beam energy 0.9 keV show similar initial peaks and further peaks which correspond to the x-ray-determined ionization of the 4d electrons (N_{IV} shell). The intensity of the peaks is independent of primary energy above 1000 eV. Weak peaks in a more remote energy region were also observed and are attributed to ionization of the N_{III} level. (D.L.C.)

5982 STRUCTURE OF THE ENERGY SPECTRUM OF SECONDARY ELECTRONS EMITTED BY A Cu(100) SURFACE BOMBARDED WITH 4-keV He^+ IONS. Soszka, W. (Jagellonian Univ., Krakow). Phys. Lett.; 42A: No. 1, 19-21(6 Nov 1972).

The energy distribution of secondary electrons emitted by a Cu(100) surface bombarded with 4-keV He^+ ions was obtained by means of electric differentiation employing the homodyne technique. In its high-energy part, the spectrum reveals structure which may be associated with autoionization of neutralized helium atoms adsorbed by the surface and perhaps with the formation of volume and surface plasmons. (auth)

5983 FURTHER EVIDENCE AGAINST A CHANNELING EFFECT IN THE OPTICAL EXCITATION OF ION BEAMS TRANSMITTED THROUGH SINGLE CRYSTALS OF GOLD. Newton, C. S.; MacDonald, R. J.; Sofield, C. J.; Hay, H. J. (Australian National Univ., Canberra). Phys. Lett.; 42A: No. 1, 47-8(6 Nov 1972).

The intensity and polarization of light emitted by He^+ ions excited by transmission through a single-crystal gold film were studied for the case when the He^+ ions are incident close to a ⟨111⟩ channel. No evidence for a channeling effect was observed. (auth)

5984 OPTICAL SPECTRA OF HIGH-PRESSURE HELIUM IRRADIATED BY ALPHA PARTICLES. Thiess, P. E.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 15: No. 2, 706-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Atomic and Molecular Properties

Refer also to abstract 6034.

5985 ENERGY OF INTERACTION BETWEEN TWO HYDROGEN ATOMS BY THE CONTRACTED GAUSSIAN-TYPE FUNCTIONS. Urban, M.; Lavicky, T. (Komensky Univ., Bratislava). Chem. Phys. Lett.; 16: No. 3, 563-7(15 Oct 1972).

It was found that contracted gaussian functions with scaled exponents lead to good binding-energy curves of the hydrogen molecule and that the scaling parameters of the exponents of gaussian functions are very similar to the scaling parameters of the Slater orbitals, mainly for s-type functions. (auth)

5986 USE OF THE METHOD OF DIATOMICS-IN-MOLECULES IN FITTING AB INITIO POTENTIAL SURFACES: THE SYSTEM HeH_2^+. Kuntz, P. J. (Univ. of Wisconsin, Madison). Chem. Phys. Lett.; 16: No. 3, 581-3(15 Oct 1972).

An illustration of how a semi-empirical method can be used to represent a potential energy surface obtained from an ab initio calculation is presented. A simple equation derived from the diatomics-in-molecules (DIM) formalism is fit to an ab initio collinear potential surface for HeH_2^+, and the resulting potential function is used to construct a surface for nonlinear geometries. (auth)

5987 INFLUENCE OF FINITE DISTANCE BOUNDARY CONDITIONS ON THE QUANTIZATION OF THE HYDROGEN ATOM. Janssens, P.; Van Dooren, R.; Delchambre, M. (Univ., Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 57: No. 5, 545-58(1971). (In French).

The quantum states of a bounded particle in a spherical symmetric potential are studied under the influence of different nonclassical boundary conditions, such as annulling the wave function upon a given sphere. The cases of Schrödinger, Klein–Gordon, and Dirac equations are examined. (auth)

5988 CLASSICAL-LIMIT QUANTIZATION OF NONSEPARABLE SYSTEMS: MULTIDIMENSIONAL WKB PERTURBATION THEORY. Doll, J. D.; Miller, W. H. (Univ. of California, Berkeley). J. Chem. Phys.; 57: No. 10, 4428-34(15 Nov 1972).

A general dynamical system of N degrees of freedom is considered as a zeroth-order separable part plus a nonseparable perturbation, and explicit formulas are derived for the classical-limit approximation to the eigenvalues through second order in the nonseparable interaction. As a numerical example, the first and second order perturbation energies of the helium atom are calculated semiclassically, and agreement with the exact quantum mechanical values is quite reasonable. (auth)

5989 WAVEFUNCTION FOR THE HYDROGEN MOLECULAR ION. Varshni, Y. P.; Lam, C. S. (Univ. of Ottawa). J. Phys., B (London); 5: No. 10, 1833-6(Oct 1972).

A two-parameter wave function for the $1s\sigma$ ground state of H_2^+ is proposed and is shown to give good results for the energy over a wide interval of the internuclear separation. Comparison is made with results obtained from several other wave functions. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstract 6846.

Collision Phenomena

Refer also to abstracts 5393 and 6885.

5990 (CEA-CONF-2027) COLLISIONAL ANGULAR SCATTERING OF ATOMS IN THE ENERGY RANGE FROM 40 TO 100 keV. Eliot, M.; Guidini, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 6p. (In French). (CONF-720552-1). Dep. NTIS (U. S. Sales Only).

From 6th conference on collisions of atoms and electrons; Liege, Belgium (17 May 1972).

The angular distributions of atoms scattered during atom–atom collisions were studied at incident particle energies of 40, 60, 80, and 100 keV for the systems H–Ne, H–Ar, He–He, He–Ne, He–Ar, Ne–Ne, Ne–Ar, and Ar–Ar. The angular distributions measured were normalized and compared with the classically calculated differential cross sections. For the light systems He–He, H–Ar, H–Ne, He–Ne, and He–Ar the decrease of the angular distributions of the scattered neutral atoms is generally very close to the decrease of the theoretical differential-cross-section curves. For the heavy systems Ne–Ne, Ne–Ar, and Ar–Ar the angular distributions decrease more rapidly than the theoretical curves beginning at an angle that varies as a function of the energy. (J.S.R.)

5991 CHARGE STATES AND CHARGE-CHANGING CROSS SECTIONS OF FAST HEAVY IONS PENETRATING THROUGH GASEOUS AND SOLID MEDIA. Betz, Hans-Dieter (Massachusetts Inst. of Tech., Cambridge). Rev. Mod. Phys.; 44: No. 3, 465-539(Jul 1972).

The experimental and theoretical situations concerning charge states and charge-changing cross sections of heavy ions up to and including uranium, which penetrate through gaseous and solid targets with velocities primarily in the range $v_0 < v < Zv_0$ ($v_0 = e^2/\hbar = 2.188 \times 10^8$ cm/s), are surveyed. Particular emphasis is given to ions with atomic numbers in the range $16 \leq Z \leq 92$. The published literature is covered through August 1971. General physical and mathematical relations are outlined, which describe the composition of charge states in a heavy-ion beam that passes through matter. Recent experimental techniques and methods of data analysis are summarized. Extensive experimental results on heavy-ion equilibrium charge-state distributions, average equilibrium charge states, and cross sections for capture and loss of one or more electrons in single encounters with target atoms are presented and critically examined. The data extend to ions as heavy as uranium and energies up to ~400 MeV. Systematic trends are emphasized and generalizations are discussed, which allow interpolations and to some extent extrapolations of the data to ranges that have not been investigated experimentally. Attention is given to the cross sections for multiple-electron loss, which are relatively large but poorly understood. Effects of residual ion excitation on charge-changing collisions are discussed in the light of recent experimental results. It is shown that the average equilibrium charge of heavy ions can be approximated by utilizing both theoretical concepts originating from the work of Bohr and Lamb and semiempirical relations based on observed regularities of the data. Recent interpretations of phenomena associated with density effects, i.e., with the increase of projectile ionization observed for increasing target densities, are scrutinized, and refinements of the theory by Bohr and Lindhard are explored. (168 references) (auth)

5992 VARIATIONAL METHODS FOR MULTICHANNEL SCATTERING. Nesbet, R. K.; Oberoi, R. S. (IBM Research Lab., San Jose, Calif.). Phys. Rev. A; 6: No. 5, 1855-62(Nov 1972).

Several methods have recently been proposed for avoiding computational anomalies in the multichannel variational formalism of Kohn. The proposed methods themselves have characteristic difficulties, discussed in detail here, leading to ambiguous or discontinuous results. Two new methods are proposed. One, the optimized minimum-norm (OMN) method, is a development of the minimum-norm method of Harris and Michels. The other, the optimized anomaly-free (OAF) method, applies the idea of a preliminary unitary transformation of the open scattering channels to the anomaly-free method of Nesbet. Model calculations are reported that show both OMN and OAF methods to be superior to earlier methods. The OAF method has the additional advantage of avoiding anomalies that occur in the OMN method. (auth)

5993 COLLISIONS BETWEEN ELECTRONS AND H_2^+ IONS. 3. MEASUREMENTS OF PROTON PRODUCTION CROSS SECTIONS AT LOW ENERGIES. Peart, B.; Dolder, K. T. (Univ. of Newcastle upon Tyne, Eng.). J. Phys., B (London); 5: No. 8, 1554-58(Aug 1972).

Inclined beams of electrons and H_2^+ ions were used in measurements of cross sections for proton production with interaction energies between 3.45 and 31.5 eV. The source used produced the ions under clearly defined conditions. The cross section was 11.6 πa_0^2 at 3.45 eV and decreased with increasing energy over the whole energy range. There is some evidence of structure between 10 and 20 eV, which is not predicted by an extension of the theoretical work of Peek (Phys. Rev., 154: 52 (1967)) and Peek and Green (Phys. Rev., 183: 202 (1969)) to lower interaction energies. (auth)

5994 CLASSICAL DYNAMICS OF THREE-BODY RECOMBINATION VIA THE RESONANCE COMPLEX MECHANISM. Whitelock, P. A. (Brookhaven National Lab., Upton, N. Y.); Muckerman, J. T.; Roberts, R. E. Chem. Phys. Lett.; 16: No. 3, 460-3(15 Oct 1972).

Exact three-dimensional classical trajectories were computed for bimolecular collisions of highly excited quasi-bound states of the hydrogen molecule with stable H_2. The de-excitation cross sections obtained from an analysis of these trajectories were used in the computation of rate constants for the reaction $H + H + M \rightarrow H_2 + M$ according to the resonance theory of recombination. The so-called "energy transfer" mechanism, as opposed to the "chaperon" mechanism, was shown to be dominant for the case of $M = H_2$. (auth)

5995 THERMAL-ENERGY CHARGE-TRANSFER REACTIONS OF RARE-GAS IONS TO METHANE, ETHANE, PROPANE, AND SILANE. THE IMPORTANCE OF FRANCK–CONDON FACTORS. Bowers, Michael T. (Univ. of California, Santa Barbara); Elleman, Daniel D. Chem. Phys. Lett.; 16: No. 3, 486-91(15 Oct 1972).

Thermal-energy charge-transfer rate constants from He^+, Ne^+, Ar^+, Kr^+, and Xe^+ to CH_4, CD_4, C_2H_6, C_3H_8, and SiH_4 were measured using ion cyclotron resonance spectroscopy. The data are interpreted in terms of a model that presumes the magnitude of the rate constant is directly related to the magnitude of the Franck–Condon factor connecting the molecular neutral and ion. Additional measurements between N_2O^+, CO_2^+, CO^+, and N_2^+ charge transferring to SiH_4 indicate the ion–neutral collision distorts the Franck–Condon manifold from that appropriate to sudden ionization processes (photon or electron impact). (auth)

5996 THERMAL-ENERGY CHARGE-TRANSFER REACTIONS OF VARIOUS PROJECTILE IONS TO METHANE. RESONANCE EFFECTS IN NONORBITING COLLISIONS. Gauglhofer, J.; Kevan, L. (Wayne State Univ., Detroit). Chem. Phys. Lett.; 16: No. 3, 492-4(15 Oct 1972).

Thermal-energy charge-transfer rate constants of a variety of projectile ions of different recombination energies with methane have been measured by ion cyclotron resonance. Rate constants exceeding Langevin values and energy resonance effects are observed, which indicate nonorbiting collisions. The resonance effects for 50-eV and thermal ions suggest that distorted Franck–Condon factors apply to the nonorbiting thermal-energy collisions. (auth)

5997 APPARENT CHARGE-TRANSFER REACTION $O^+ + CO \rightarrow CO^+ + O$. Murad, E. (Air Force Cambridge Research Labs., Bedford, Mass.). Chem. Phys. Lett.; 16: No. 3, 548-9 (15 Oct 1972).

The apparent charge-transfer reaction betwen O^+ and CO was studied and the cross section was measured as a function of energy for E_{lab} = threshold (≈0.6 eV) to 100 eV. For ground state ions a threshold is observed; in addition a break in the curve is observed at $E_{lab} = 3$ to 4 eV. The effect of electronic excitation in the reactant O^+ and the cause of the break in the cross section curve are briefly discussed. Preliminary results with isotopic labeling suggest that both electron transfer and atom pick-up processes occur. (auth)

5998 DEPOLARIZATION CROSS SECTION OF SODIUM D LINES FOR COLLISIONS WITH HELIUM. Masnou-Seeuws, F.; Roueff, E. (Observatoite de Paris, Meudon, France). Chem. Phys. Lett.; 16: No. 3, 593-7(15 Oct 1972).

Depolarization cross sections for the reaction $Na\ ^2P_{|m} + He(^1S_0) \rightarrow Na\ ^2P_{|m'} + He(^1S_0)$ are computed using an impact-parameter treatment. Comparison with experimental results is given. The exact calculation is compared to the results of a simplified model where the sodium atom is supposed to be unperturbed for internuclear distances $R > 14$ au, and the state of the quasi molecule is represented by Hund's case b for internuclear distances $R < 14$ au. The agreement between exact computation, simplified model, and experimental results shows that even for low velocities the main part of the mechanism is Coriolis coupling between Π molecular states. (auth)

5999 REPULSIVE PART OF THE POTENTIAL BETWEEN Hg ATOMS AND LIGHT ATOMIC PROJECTILES. van Wijngaarden, A.; Miremadi, B.; Baylis, W. E. (Univ. of Windsor, Ont.). Can. J. Phys.; 50: No. 17, 1938-48(1 Sep 1972).

Interatomic potentials are studied by means of a crossed-beam apparatus consisting of a target chamber in which a monoenergetic beam of H, He, B, and N ions of energies $E < 70$ keV interacts with a thermal beam of Hg atoms. Angular distributions for the scattering of all charge states of ^1H, ^4He, ^{11}B, and ^{14}N are measured in the range of $17° < \theta_L < 60°$. All measured cross sections are in good agreement with the theory for scattering in a Thomas–Fermi potential to which Lindhard's theoretical estimates are shown to be quite accurate approximations. A Padé approximant is derived for the Thomas–Fermi potential and is used to calculate tables of Thomas–Fermi scattering parameters. (auth)

6000 ELECTRON ENERGY-LOSS SPECTROSCOPY OF NAPHTHALENE VAPOR. Huebner, R. H. (Argonne National Lab., Ill.); Mielczarek, S. R.; Kuyatt, C. E. Chem. Phys. Lett.; 16: No. 3, 464-9(15 Oct 1972).

The naphthalene energy-loss spectrum from 3 to 16 eV obtained for 100-eV incident electrons closely resembles photoabsorption results. The need to include Rydberg configurations for any theo-

retical analysis of the spectrum is emphasized. The data yield an integrated oscillator strength of 8.6 below 15.1 eV. (auth)

6001 LOW-ENERGY ELECTRON-MOLECULE SCATTERING. Takayanagi, K. (Tokyo Univ.). Comments At. Mol. Phys.: 3: No. 4, 95-106(Jul 1972).

It is stated that the Born approximation is surprisingly applicable to low-energy electron–molecule scattering, where the distortion of the electron wave function is considerable, and that the approximation is indeed applicable to the rotational excitation of molecules by low-energy electrons. The main purpose of the present communication is to supplement the authors' previous review (Advan. Atom. Mol. Phys., 6: 105(1970)), with emphasis on a resonance-type phenomenon in electron–polar-molecule scattering. The situation in electron–homonuclear-diatomic-molecule scattering is also summarized. (UK)

6002 SIMULTANEOUS COULOMB EJECTION OF K- AND L-SHELL ELECTRONS BY HEAVY, CHARGED PROJECTILES. Hansteen, J. M.; Mosebekk, O. P. (Univ. of Bergen, Norway). Phys. Rev. Lett.; 29: No. 20, 1361-2(13 Nov 1972).

The recently observed multiple inner-shell Coulomb ionization induced by swift, heavy ions is treated by a semiclassical method. Impact-parameter dependences and multiple ionization probabilities as functions of the projectile energy are given and discussed in relation to experimental data. (auth)

6003 ASPECTS OF ELASTIC SCATTERING EMBEDDED IN BORN'S TREATMENT OF EXCITATION AND OF ELECTRON CAPTURE. I. WAVE VERSION. Bates, D. R.; McDonough, W. R. (Advanced Research Projects Agency, Washington, DC). Comments At. Mol. Phys.; 3: No. 5, 153-9(Sep 1972).

The Born approximation to the matrix element associated with excitation may be arranged so that it may be factorized, one of the three factors showing that the sum of the linear momenta of the projectile particle and of the electron of the target system is conserved in the collision and another being simply the elastic scattering matrix element. The problem is surveyed, briefly noting certain close similarities to the classical binary encounter approximation. The interesting case of electron capture is also considered. (7 references) (auth)

6004 ASPECTS OF ELASTIC SCATTERING EMBEDDED IN BORN'S TREATMENT OF EXCITATION AND OF ELECTRON CAPTURE. II. IMPACT PARAMETER VERSION. Bates, D. R.; McDonough, W. R. (Advanced Research Projects Agency, Washington, DC). Comments At. Mol. Phys.; 3: No. 5, 161-5(Sep 1972).

Extraction of the elastic scattering matrix element from the impact-parameter version of Born's approximation for heavy-particle collisions must be possible, just as it is in the wave version (which for such collisions is effectively equivalent). This leads to a useful new formula. (6 references) (UK)

6005 FIELD-THEORETIC APPROACH TO ATOMIC SCATTERING. Das, J. N. (Univ. of Calcutta). Ann. Phys. (Leipzig); 28: No. 1, 6-14(1972).

Scattering of two complex atomic systems has been considered in a field-theoretic way. It is observed that in this approach several deficiencies of ordinary wave mechanical theory for processes like rearrangement collisions can be remedied. The formalism is, however, primarily aimed at providing results that may be useful in discussing relativistic atomic scattering of the most general type. Electron–hydrogen scattering and atom–ion charge-transfer are considered as examples. (auth)

6006 IONIZATION CROSS SECTIONS OF F_2 AND Cl_2 BY ELECTRON IMPACT. Center, R. E.; Mandl, A. (Avco Everett Research Lab., Everett, MA). J. Chem. Phys.; 57: No. 10, 4104-6(15 Nov 1972).

A measurement was made of the electron-impact ionization cross section of F_2 and Cl_2 over the energy range 15 to 100 V. Both species exhibit a maximum cross section at electron energies near 100 eV, the maximum values being approximately 1.5×10^{-16} and 7.0×10^{-16} cm^2 for F_2 and Cl_2, respectively. The measurement in Cl_2 fits an observed correlation between the maximum cross section and the square root of the polarizability. This correlation seems to apply to a wide variety of atomic and molecular species. Based on this correlation the polarizability of F_2 is estimated to be approximately 8×10^{-25} cm^3. (auth)

6007 PRODUCT INTERNAL STATE DISTRIBUTIONS FROM INTERACTIONS OF METASTABLE Ar WITH N_2. Cosby, P. C.; Moran, T. F. (Georgia Inst. of Tech., Atlanta). J. Chem. Phys.; 57: No. 10, 4111-15(15 Nov 1972).

Internal energy state distributions of the products from reactions of metastable Ar($^3P_{2,0}$) atoms with $N_2(X\ ^1\Sigma_g^+)$ molecules have been computed from a statistical phase space treatment of the interactions. Calculated rotational and vibrational distributions have been compared with those measured in recent spectroscopic experiments involving metastable Ar atoms. For strongly exothermic reactions producing $N_2(B\ ^3\Pi_g, \nu', J')$ molecules, the computed vibrational distribution is significantly broader than that measured experimentally. The corresponding vibrational and rotational distributions calculated for slightly exothermic $N_2(C\ ^3\Pi_u, \nu', J')$ channels are in qualitative accord with experimental distributions; however, some features present in the experimental product distributions are not reproduced by the statistical model. (auth)

6008 MONTE CARLO CLASSICAL TRAJECTORY CALCULATION OF THE RATES OF F-ATOM VIBRATIONAL RELAXATION OF HF AND DF. Thompson, D. L. (Los Alamos Scientific Lab., NM). J. Chem. Phys.; 57: No. 10, 4164-9(15 Nov 1972).

Rates of F-atom vibrational relaxation of HF and DF were calculated for the temperature range 600 to 2000°K using Monte Carlo classical trajectory methods. The processes $F + (D)HF(\nu) \rightarrow F + (D)HF(\nu - 1)$, where $\nu = 1$, 3, and 5 and $F + HF(0) \rightarrow F + HF(1)$ were investigated. Agreement with available experimental data is excellent. The calculations show that vibrational de-excitation is due to vibration–rotation transfer and that excitation is due to translation–vibration transfer. Multiple-quantum transfers are found to occur in de-excitation of higher vibrational levels. A semiempirical valence-bond potential-energy surface was used. No adjustments were made to the surface to cause agreement between calculated and experimental energy-transfer results. (auth)

6009 MONTE CARLO CLASSICAL TRAJECTORY CALCULATION OF THE RATES OF H- AND D-ATOM VIBRATIONAL RELAXATION OF HF AND DF. Thompson, D. L. (Los Alamos Scientific Lab., NM). J. Chem. Phys.; 57: No. 10, 4170-3(15 Nov 1972).

Monte Carlo classical trajectory methods were used to investigate H- and D-atom vibrational relaxation of HF and DF. A semiempirical valence-bond interaction surface was employed for the calculation of three-dimensional collision trajectories. Both vibration–rotation and vibration–translation are found to contribute to the vibration de-excitation. Multiple-quantum jumps contribute to the relaxation for initial excitation levels greater than $\nu = 1$. (auth)

6010 CROSS SECTIONS AND INTERPRETATION OF DISSOCIATIVE ATTACHMENT REACTIONS PRODUCING OH^-, O^-, AND H^- IN H_2O. Melton, C. E. (Univ. of Georgia, Athens). J. Chem. Phys.; 57: No. 10, 4218-25(15 Nov 1972).

Dissociative-electron-attachment cross sections for the production of OH^-, O^-, and H^- from water vapor were determined. These cross sections are discussed within the framework of resonance scattering theory. The relatively low cross sections for the production of OH^-, 1.2, 0.85, and 0.85×10^{-21} cm^2 molecule^{-1} for maxima of 6.4, 8.4, and 11.2 eV, suggest that the atoms in the H_2O^- complex are loosely bound together and behave as essentially independent entities. All of the negative ions from H_2O appear to be produced from three different electronic states of the molecule. Results from this study are used to draw a hypothetical potential-energy diagram for H_2O. (auth)

6011 ONE-ELECTRON MODEL FOR CHARGE EXCHANGE IN ION–ATOM COLLISIONS. Storm, David; Rapp, Donald (Univ. of Texas, Dallas). J. Chem. Phys.; 57: No. 10, 4278-82(15 Nov 1972).

In attempting to calculate cross sections for charge exchange in other than proton–hydrogen-atom collisions, it has been common to simplify the system by assuming that only one active electron is moving in the field of two ions. With this one-electron approximation, the extensive formalism developed to treat proton–hydrogen-atom collisions has then been applied. It is shown that the use of some common one-electron orbitals in such a formalism can destroy either the ability to interpret the expansion coefficients as transition amplitudes or probability conservation. In this work, a one-electron model Hamiltonian and corresponding expansion functions are proposed by which the physical system is more accurately described. With this model it is shown that physically acceptable transition amplitudes can be calculated, probability is conserved, and the principle of microreversibility is satisfied. (auth)

6012 ELECTRON SCATTERING BY MOLECULES WITH AND WITHOUT VIBRATIONAL EXCITATION. VI. ELASTIC SCATTERING BY CO AT 6 TO 80 eV. Truhlar, D. G. (Univ. of Minnesota, Minneapolis); Williams, Walter; Trajmar, S. J. Chem. Phys.; 57: No. 10, 4307-12(15 Nov 1972).

Elastic scattering differential cross sections in relative units for electron scattering from CO were measured in the scattering angle range 15° to 85° and the impact energy range 10 to 80 eV. The experimental results are compared to the predictions of model polarized Born approximations using five different model interaction potentials. The model potential of Crawford and Dalgarno is in the best agreement with experiment; it agrees with experiment about as well as any local potential possibly can. Such a treatment is able to account for some of the features of the angle dependence of the differential cross sections. The largest discrepancies between theory and experiment are at 10 eV and at large scattering angles, and there are also smaller discrepancies at small scattering angles. Comparisons are also made to previous experimental studies by Ramsauer and Kollath and Arnot. (auth)

6013 INELASTIC SCATTERING OF Ne^+ BY H_2 AND D_2. Mahan, B. H.; Winn, J. S. (Univ. of California, Berkeley). J. Chem. Phys.; 57: No. 10, 4321-6(15 Nov 1972).

The reaction $Ne^+(H_2,H)NeH^+$ is notable as a simple exoergic ion–molecule reaction that has a very small rate constant, less than 8×10^{-22} cc/s. The velocity vector distributions of Ne^+ scattered nonreactively from H_2 and D_2 at a number of energies were studied. There is no evidence for the occurrence of reactive or charge transfer collisions. The small-angle (<90°) scattering is elastic, but there is large-angle inelastic scattering of three types: vibration and rotational excitation of hydrogen, collisional dissociation to $Ne^+ + H + H$, and electronic excitation of hydrogen to $B\ ^1\Sigma_u^+$ and perhaps other states. The results are consistent with conclusions drawn from a molecular orbital correlation diagram for the $(Ne–H_2)^+$ system. (auth)

6014 POWER SERIES EXPANSION OF COLLISION AMPLITUDES: ELECTROSTATIC POTENTIALS. Lassettre, E. N. (Carnegie-Mellon Univ., Pittsburgh). J. Chem. Phys.; 57: No. 10, 4357-69(15 Nov 1972).

By means of a conformal transformation $t = K\ (K^2 + \alpha^2)^{-½}$ (where, in physical applications, K is the momentum change of a colliding electron) the complex K plane is mapped onto the complex t plane. With cuts from $i\alpha$ to $i\infty$ and from $-i\alpha$ to $-i\infty$, the mapping is one to one. Let I be the ionization potential from a one-electron orbital ϕ_i and W the excitation potential from ϕ_i to ϕ_j. Then if $\alpha = (2I)^{½} + [2(I - W)]^{½}$ a region of the K plane, which contains (a) no singular point of the form factor $\epsilon = \int \exp(iK \cdot r)\phi_i\phi_j^*\,(dr)$ and (b) the entire real axis of K, is mapped into the unit circle in the t plane. Hence, when ϵ is expanded into a power series in t, the series converges when $t < 1$ and the region of convergence includes all real values of K. Moreover, the coefficients of the power series in t can be simply obtained from the coefficients of a series for ϵ in powers of K. This extends to the collision amplitude a result previously obtained for the generalized oscillator strength [E. N. Lassettre, J. Chem. Phys. 43, 4479 (1965)]. The extension is nontrivial since the power series in K for ϵ contains both even and odd powers while that for oscillator strength contains only even powers of K. A particular series expansion for ϵ, which takes account of the behavior of ϵ at both large and small K, can be exploited to obtain a series expansion for an electrostatic potential function. This is possible because the Fourier transform of the potential function is proportional to ϵ/K^2. Hence, an inversion gives the potential function. A particular expansion, which expresses the potential function in terms of a set of generalized moments, is obtained, discussed in detail, and illustrated with some simple examples. (auth)

6015 ION-PAIR PRODUCTION OF O^+ AND O^- FROM O_2 BY $He(2^1S,2^3S)$ METASTABLES. Bush, Y. A. (National Oceanic and Atmospheric Administration, Boulder, CO); Albritton, D. L.; Fehsenfeld, F. C.; (and others). J. Chem. Phys.; 57: No. 10, 4501-2(15 Nov 1972).

The reaction $He(2^1S,2^3S) + O_2 \rightarrow He + O^+ + O^-$ was studied both in a flowing afterglow and in a beam apparatus. The afterglow measurement gave values for the rate constants that were between the values reported for the Penning ionization of O_2 by $He(2^1S)$ and $He(2^3S)$, respectively, which similarity indicates that all three of these products are the results of the same process, the destruction of He metastables. Existence of this reaction was further confirmed by the fact that the cross sections for production of O^+ and O^- were found to be approximately equal in the beam experiment. (A.G.W.)

6016 EXCITATION OF H ATOMS TO THE 4s STATE BY 10- TO 35-keV GROUND-STATE H-ATOM IMPACT ON H_2 AND N_2. Hughes, R. H.; Kouri, R. F. (Univ. of Arkansas, Fayetteville). J. Chem. Phys.; 57: No. 10, 4503-4(15 Nov 1972).

Measurement of the absolute cross sections for the collisional reaction $H(1s) + T \rightarrow H(4s) + T^*$ is reported, where T represents ground-state H_2 or N_2 targets and T* represents these targets in final states, including excited as well as ground states. The kinetic energy range of the H-atom projectiles was from 10 to 35 keV. Comparison with results of others for excitation to the 3s state shows that the ratio of 3s excitation to 4s excitation is strikingly similar for impact on H_2 and N_2. The ratio is three for all energies. (A.G.W.)

6017 GLAUBER TYPE EIKONAL APPROXIMATION FOR ANGLE TRAJECTORIES. Chen, J. C. Y.; Hambro, L. (Univ. of California, La Jolla, San Diego). J. Phys., B (London); 5: No. 10, L199-203(Oct 1972).

The Glauber-type eikonal approximation is examined with the classical trajectories taken as two intersecting straight-line segments. The increased generality in the trajectories provides a significant improvement for large-angle scattering and in the meantime does not alter the simple form of the Glauber-eikonal approximation for straight-line trajectories. Numerical illustrations are given for both the differential and total elastic e–H scattering. (auth)

6018 DIFFERENTIAL CROSS SECTIONS IN THE p^+–H COLLISIONS. Chen, J. C. Y.; Ishihara, T.; Ponce, V. H.; Watson, K. M. (Univ. of California, La Jolla, San Diego). J. Phys., B (London); 5: No. 10, L204-6(Oct 1972).

Elastic, electron-transfer, and $(2p_z)$-excitation differential cross sections for p^+–H collisions are calculated in the $1s\sigma_g$–$2p\sigma_u$–$2p\pi_u$ three-state expansion. The results are in satisfactory agreement with the newly obtained experimental data. The spurious long-range nonadiabatic interaction found in previous calculations does not appear in the calculation. (auth)

6019 100 AND 200 keV POSITRON SCATTERING BY ATOMIC NUCLEI. Kobayashi, T.; Shimizu, S. (Kyoto Univ.). J. Phys., B (London); 5: No. 10, L211-13(Oct 1972).

The differential cross sections for elastic scattering of positrons by Se and Bi were measured at 30°, 40°, 60°, and 85° for energies of 100 and 200 keV and compared with the Mott theory. Though the experimental results were, on the whole, in agreement with the theory, the measured cross sections tend to be a little lower than the theoretical ones. (auth)

6020 DISPERSION RELATION FOR THE COULOMB T MATRIX. Richards, D.; McDowell, M. R. C. (Royal Holloway Coll., London). J. Phys., B (London); 5: No. 10, 1811-22 (Oct 1972).

It is shown that the Coulomb T matrix satisfies a dispersion relation off-shell. In the half-on-shell case ($k^2 = k_f^2 \neq k_i^2$ or $k^2 = k_i^2 \neq k_f^2$) this provides an unambiguous definition for the imaginary part in terms of a generalized function. A subtractive procedure is introduced to extend these results to the real part. (auth)

6021 ELECTRON IMPACT THRESHOLD EXCITATION OF CO BY THE TRAPPED-ELECTRON METHOD. Reinhardt, J.; Joyez, G.; Mazeau, J.; Hall, R. I. (Univ., Paris). J. Phys., B (London); 5: No. 10, 1884-9(Oct 1972).

A threshold excitation spectrum of CO, obtained with an improved resolution, is presented and much structure is identified. Observation of the behavior of the excitation cross section in the threshold region leads to evidence supporting the assignment of the configuration $CO^- \ldots 1\pi^4 5\sigma 6\sigma^2\ ^2\Sigma^+$ to the resonance at 10.04 eV and also reveals resonances at 10.6 and 11.1 eV that form a series, with the 10.04 eV resonance as lowest member, associated with the $b^3\Sigma^+$ and $B^1\Sigma^+$ states. (auth)

6022 RESONANCES IN ELECTRON SCATTERING FROM CO. Mazeau, J.; Gresteau, F.; Joyez, G.; Reinhardt, J.; Hall, R. I. (Univ., Paris). J. Phys., B (London); 5: No. 10, 1890-7(Oct 1972).

An electron-impact spectrometer was employed to study resonance phenomena associated with the 10.04-eV Feshbach resonance of CO. The $^2\Sigma^+$ symmetry of this resonant state is confirmed, and strong evidence indicates the $b^3\Sigma^+$ and $B^1\Sigma^+$ states as parents. A $^2\Sigma^+$ resonance at threshold and two shape resonances are observed in the $b^3\Sigma^+$ $\nu' = 0$ level excitation cross section at 10.7 and 11.2 eV, the 10.7-eV resonance is shown to have $^2\Pi$ symmetry. Other Feshbach resonances are detected at 11.3 and 12.2 eV. (auth)

6023 EXCITATION OF AUTOIONIZED $^3P^-$ STATES AND THE RESONANCE IONIZATION OF THE HELIUM ATOM BY ELECTRON IMPACT. Pavlichenkov, A. V.; Senashenko, V. S. (Moscow State Univ.). J. Phys., B (London); 5: No. 10, 1898-1905(Oct 1972).

The first stage of the process (the excitation of autoionized

$^3P^{(-)}$ states by electrons) and its second stage (the resonance ionization of the helium atom) are considered on a unified basis within the framework of Fano's theory using the diagonalization method for the description of the properties of autoionized states. A qualitative comparison of the results obtained with the existing experimental data is made. (auth)

6024 POLARIZATION OF CHARACTERISTIC X RADIATION EXCITED BY ELECTRON IMPACT. McFarlane, S. C. (Univ. of Stirling, Eng.). J. Phys. B (London); 5: No. 10, 1906-15 (Oct 1972).

Using hydrogenic wave functions, the cross sections for ionization of an atom from the magnetic substates of the L_3 level are calculated in (i) the Bethe approximation and (ii) the first Born approximation. Calculation (ii) differs from previous work of a similar nature in that it takes as axis of quantization the direction of the incident electron beam. Hence the polarization of the resulting characteristic x radiation is estimated; it is found to be small in comparison with the degree of polarization that typically results from the excitation of optical lines, in marked disagreement with a previous calculation. (auth)

6025 SIMULTANEOUS EXCITATION AND IONIZATION OF HELIUM BY ELECTRON IMPACT. Gillespie, E. S. (Queen's Univ., Belfast). J. Phys., B (London); 5: No. 10, 1916-21 (Oct 1972).

Cross sections were calculated for the processes $e + He \rightarrow e + He^+(nl) + e$ for $l = 0,1$ and $n = 2,3,4$ employing the Born approximation and a Hartree–Fock function for the ground state of helium. In the case of the p bound electron the results are compared with results in which a simple Hylleraas ground-state wave function is used and also in which the effective nuclear charge (Z) depends on the momentum of the ejected electron. The dependence of the cross sections for the two processes on the values of Z is discussed, and a method for the evaluation of an average value of Z is suggested. (UK)

6026 FREDHOLM–PADE APPROXIMATIONS IN SCATTERING THEORY. Liew, Y. C.; Moiseiwitsch, B. L. (Queen's Univ., Belfast). J. Phys., B (London); 5: No. 10, 1922-7 (Oct 1972).

New formulas for the transition matrix, in which certain quantities arising in the second-order Fredholm approximation are chosen according to prescriptions given by the Padé approach, are assessed by application to a schematic model scattering problem involving a pair of coupled channels with square well potentials. The formulas are found to be very satisfactory, provided the potentials are not too strong, and superior to the ordinary second-order Fredholm approximation. The case in which the potential occurring in the second channel is very strong is considered with particular reference to the scattering of electrons by atomic hydrogen. (auth)

6027 LOW ENERGY INELASTIC SCATTERING OF ELECTRONS BY ATOMS. Carse, G. D. (Univ. of Melbourne). J. Phys. B (London); 5: No. 10, 1928-37(Oct 1972).

The differential and total cross sections for the elastic and inelastic scattering of electrons by mercury and sodium are computed in the energy range of the dominant quantum level transitions, 6.703 eV 6s–6p and 2.104 eV 3s–3p, respectively. The cross sections are calculated in the close-coupling approximation and agree satisfactorily with experimental results and other calculations. (auth)

6028 ELASTIC SCATTERING OF ELECTRONS BY HYDROGEN MOLECULES. Khare, S. P.; Shobha, P. (Meerut Univ., India). J. Phys., B (London); 5: No. 10, 1938-49(Oct 1972).

Differential and total cross sections for the elastic scattering of 30- to 912-eV electrons by hydrogen molecules are calculated in the plane-wave approximation. The interaction potential consists of the first-order static potential and the second-order adiabatic and nonadiabatic potentials. One-center wave functions are employed to obtain the static potential, and the effect of exchange is included by employing the Ochkur approximation. The differential cross sections include terms up to only third order in the interaction energy and are in fair accord with the experimental data. (auth)

6029 ELECTRON DETACHMENT IN COLLISIONS INVOLVING 4 TO 30 keV He^- AND H^- IONS. Simpson, F. R.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London); 5: No. 10, 1959-64(Oct 1972).

Electron detachment cross sections for He^- and H^- ions in hydrogen, helium, and argon were determined in the energy range 4 to 30 keV. While cross sections for He^- impact are larger than the corresponding cross sections for H^- impact, a similar energy dependence is observed. (auth)

6030 ASYMPTOTIC EXPANSION OF DOUBLE-CONTINUUM COULOMB WAVEFUNCTION. Peterkop, R.; Rabik, L. (Inst. of Physics, Riga). J. Phys., B (London); 5: No. 10, 1823-32 (Oct 1972).

Various forms of the asymptotic expansion of the wave function describing two outgoing electrons in the field of the nucleus are considered for a simple model problem. The connection with the asymptotic behavior of the Fourier expansion is determined. Numerical calculations are carried out to determine the region where the asymptotic expansion becomes valid. (auth)

6031 IMPORTANCE OF ELECTRONIC CORRELATIONS FOR THE CALCULATION OF X RAY AND FAST ELECTRON SCATTERING BY Ne (^1S). Naon M.; Cornille, M. (CMOA, Paris). J. Phys., B (London); 5: No. 10, 1965-74(Oct 1972).

The elastic, inelastic, and total intensities of diffraction for fast electrons and the coherent, incoherent, and total scattering for x rays by the neon atom in its ground state were studied using the atomic Bethe–Goldstone equations, which give about 97.3% of the empirical correlation energy. The results are compared with those obtained with two configuration-interaction wave functions and the Clementi wave function, which give respectively 85%, 53%, and 20% of the correlation energy. The Hartree–Fock results are also given. It is shown that a properly correlated wave function is necessary when one wants to compare carefully the theoretical and experimental scattering intensities. (auth)

Atomic Theory

Refer also to abstract 6881.

6032 IMPORTANCE OF PAIR CORRELATIONS IN THE MANY-BODY THEORIES OF CLOSED-SHELL ATOMS. Kansa, Edward John. Nashville; Vanderbilt Univ. (1972). 223p. University Microfilms Order No. 72-26,110.

Thesis.

It is argued that the most convenient reference state of a many-body expansion of the exact wave function is the restricted Hartree–Fock (RHF) wave function, which is represented by a symmetry-adapted Slater determinant. A superposition of configurations (SC) formalism, which is required to correspond to the linked cluster perturbation theory (LCPT) expansion, is developed. Two assumptions are made: the reference wave function of a closed-shell atom is the RHF wave function, and the mutually orthonormal occupied and virtual orbitals are generated from a common RHF potential, V_N. With these assumptions, it can be shown that the SC expansion is greatly simplified. The SC matrix elements are decomposed into three classes of two-body matrix elements. By distinguishing between connected and disconnected SC coefficients, one can show that the LCPT expansion can be obtained by iterating the coefficients. An SC coefficient is made to vanish if its corresponding configuration does not possess the correct symmetry eigenvalues. The SC coefficients are recognized to be coupled sets of integral equations of the first and second kind when the virtual orbitals are generated from the V_N potential. Making use of correspondence between the SC and LCPT expansions allows one to make reasonable simplifications and approximations. The SC formalism developed here was applied to groundstate ^1S configurations of the atoms helium and beryllium. The reference wave function of He was taken to be Goddard's GF wave function, and the reference wave function of Be was taken to be Clementi's RHF wave function. The numerical calculations were performed on the Vanderbilt University XDS Sigma-7 computer. A correlation energy of −0.0931 au was obtained for Be, and a correlation energy of −0.0258 au was obtained for He. It is suggested that the arbitrariness of the definition of H_0 be explored to obtain the optimum choice of the RHF virtual orbitals. An improvement of the choice of the RHF virtual orbitals should lead to a more rapidly converging SC or LCPT expansion. (Diss. Abstr. Int., B)

6033 CHECKS OF THE ALGEBRAIC MATRICES FOR THE CONFIGURATIONS $(d + s)^n p$. Roth, Charles (National Bureau of Standards, Washington, D. C.). J. Res. Nat. Bur. Stand.; 76B: No. 1-2, 61-80(1972).

By constructing suitable combinations of algebraic matrices enabling the resulting eigenvalues to be predicted theoretically, checking parameters were obtained for 32 interaction parameters of the configuration $(d + s)^n p$. (auth)

6034 NONSYMMETRIC PERTURBATION STUDIES OF ONE-ELECTRON DIATOMIC MOLECULAR IONS. Schulman, J. M.

(Queen's Coll., Flushing, NY). J. Chem. Phys.; 57: No. 10, 4413-15(15 Nov 1972).

The interaction of a hydrogenic atom with a bare nucleus is studied perturbatively through infinite order in a model problem. Convergence of the energy and wave-function expansions are discussed in Rayleigh–Schrödinger and Brillouin–Wigner non-symmetric pertubation theories. (auth)

6035 IMPROVED BOUND WAVEFUNCTIONS FOR COMPLEX ATOMS. Nussbaumer, H. (Observatoire de Paris, Meudon, France). J. Phys., B (London); 5: No. 10, 1837-43 (Oct 1972).

A multiconfiguration expansion in view of an improved angular representation of complex atoms is explored by employing two types of radial functions. When applied to C^{+2} the calculated energy separation is much improved compared to the more traditional multiconfiguration method restricted to one complex. Resulting transition probabilities are closer to experimental values than those of older calculations. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 5171.

6036 EQUATIONS OF THE ELECTROHYDRODYNAMICS OF MULTIPHASE MEDIA: ONE-DIMENSIONAL FLOWS, DISCONTINUOUS SOLUTIONS, AND DAMPING OF WEAK WAVES. Gogosov, V. V.; Farber, H. L. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 5, 57-70(1972). (In Russian).

Equations of motion are presented for multi-phase media: a gas, charged droplets, solid particles, and free ions, in EHD approximations. Different forms of Ohm's law are derived for such media. A "freezing-in" integral is obtained for the liquid phase that was valid when the velocities of the gaseous and liquid phases coincide. The problem of a unidimensional steady-state flow with a complex Ohm's law for the liquid phase is examined. When the electric field is assumed constant, the solution of the problem leads to solution of the corresponding problem in ordinary EHD by means of inserting new symbolism. The propagation of weak waves is investigated for the case when the influence of a liquid phase on the gaseous one may be neglected. The damping decrement is included in the consideration and related to the energy exchange between components that arises in consequence of a difference in the mechanical properties of components, temperature changes, and chemical potentials in the transmission of a wave. (tr-auth)

6037 POLOIDAL AND TOROIDAL POTENTIALS FOR SOLENOIDAL FIELDS. Warner, W. H. (Univ. of Minnesota, Minneapolis). Z. Angew. Math. Phys.; 23: No. 2, 221-30(1972).

Representation of solenoidal vector fields by poloidal and toroidal scalar fields relative to a fixed spatial direction is shown to be sufficient in the sense that any such vector field determines the scalar functions. The potentials are expressible by logarithmic potentials, and harmonic functions derived from them, over two-dimensional slices of the domain. The nature of the non-uniqueness of the scalar fields is discussed. Comments on applications, particularly in convection problems, are made. (auth)

6038 EFFECTS OF MAGNETIC FIELD OSCILLATIONS ON THE BOUNDARY LAYER FLOW PAST A MAGNETIZED PLATE. Mohanty, H. K. (Indian Inst. of Tech., Kharagpur). Z. Angew. Math. Phys.; 23: No. 2, 325-32(1972).

The effects of harmonic oscillations of amplitude ϵ in the magnitude of the magnetic field on the steady boundary layer flow $O(\epsilon^2)$ due to a uniform free stream past a semi-infinite magnetized flat plate are discussed. It is observed that the magnetic field distribution does not affect the surface current distribution. (auth)

6039 STEADY NONLINEAR EKMAN–HARTMANN BOUNDARY LAYERS. Benton, E. R. (Univ. of Colorado, Boulder); Chow, J. H. S. Phys. Fluids; 15: No. 12, 2174-81(Dec 1972).

The steady, axially symmetric Ekman–Hartmann boundary layer on a flat insulating surface is analyzed in its fully nonlinear form. Emphasis is placed on evaluation of Ekman pumping and induced Hartmann current as functions of Rossby number, magnetic interaction parameter, and magnetic Prandtl number. Significant quantitative departures from the estimates of linear theory are found. Yet, for some purposes (such as for predicting its influence on spin-up) the strength of this hydromagnetic pump is shown to be adequately described by an analytic series solution truncated after the terms quadratic in Rossby number. (auth)

6040 INVESTIGATION OF THE BOUNDARY LAYER OF A TOTALLY IONIZED DUAL-TEMPERATURE PLASMA AT THE NONCONDUCTING WALL OF AN MHD CHANNEL. Korovin, V. M. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 5, 45-56(1972). (In Russian).

The flow of a two-temperature plasma in boundary layers at the non-conducting wall of a MHD duct in the presence of electric and magnetic fields was studied. The complete energy equation was used for the electron component; the change of parameters of the external current was also considered. (K.S.W.)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 5787 and 6097.

6041 (ORO-2504-183) INVESTIGATIONS ON THE PROPERTIES OF K MESONS AND HYPERONS AND RELATED TOPICS IN HIGH ENERGY PHYSICS. Technical Report 73-010. Progress Report. Snow, George A. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Aug 1972. Contract AT(40-1)-2504. 52p. Dep. NTIS.

Research in high energy physics using counter–spark chambers and bubble chambers is summarized. A list of publications is included. (J.F.P.)

6042 SEARCH FOR FRACTIONAL CHARGE (QUARKS) USING A LOW-TEMPERATURE TECHNIQUE. Hebard, A. F.; Fairbank, W. M. (Stanford Univ., Calif.). pp 855-7 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A low-temperature apparatus capable of detecting electric charge smaller than that of an electron on superconducting niobium spheres is described. Preliminary results obtained for a single sphere of mass 7×10^{-5} grams indicate a nonzero residual charge of approximate magnitude $-\frac{1}{3}$ e. Efforts are being made to determine whether this is real or spurious. (auth)

6043 NUCLEAR INTERACTIONS IN THE ATMOSPHERE AT ENERGIES $>10^{14}$ eV. Zhdanov, G. B.; Brikker, S. I.; Podgurskaya, A. V.; Poperekova, L. M. (Inst. of Cosmic Research, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1669-72(Aug 1972). (In Russian).

Two families of γ-quanta were analyzed as recorded on a photoemulsion apparatus with an ionization calorimeter 10 m^2 in area at an altitude of 3.3 km. In the series of 9 γ-quanta there was one energetically released π^0-meson which carried 5/6 of the energy of the series. The series of 33 γ-quanta may be interpreted as the result of a decay of a heavy fireball with a mass of ~20 GeV/c^2. (tr-auth)

6044 INELASTIC PROCESSES AT ENERGIES GREATER THAN 200 GeV AND BASIC FACTORS GOVERNING THEM. Gabuniya, L. L.; Garibashvili, D. I.; Ivanova, A. B.; (and others) (Inst. of Physics, Tbilisi, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1652-6(Aug 1972). (In Russian).

Experimental data on the process of multiple particle generation were examined. The process was fixed by the uniform filling in of phase volume, distorted only by the restriction of the imparted four-momenta. A comparison was made with the dual temperature distribution of Planck, allowing for correlations between transverse and longitudinal momenta. Correlations between pairs and groups of secondary particles were also drawn. (tr-auth).

6045 ANGULAR DISTRIBUTION OF CHARGED AND NEUTRAL PIONS DURING INELASTIC INTERACTIONS IN THE ENERGY REGION $E_0 > 10^{12}$ eV. Emel'yanov, Yu. A.; Ivanenko, V. M.; Lukin, Yu. T.; Sadykov, T. Kh. (Inst. of High Energy Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1810-12(Aug 1972). (In Russian).

An emulsion chamber and tracking device were combined to permit simultaneous recording of both neutral and charged pions from inelastic interactions at energies $>10^{12}$ eV. Multiplicity of secondary charged particles, multiplicity of the most energetic secondary neutral particles, the energies of secondary neutral pions, and the angular distribution of the secondary charged and the fastest neutral pions could be obtained from the apparatus described at such energies. (K.S.W.)

Electromagnetic

Refer also to abstract 5783.

6046 (CONF-700806-(Vol.1)(Absts.)) XVth INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS, KIEV, 1970. ABSTRACTS OF CONTRIBUTIONS. VOL. 1. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1970. 419p.

Abstracts in experimental high energy physics are presented covering two-body hadronic and quasi-two-body hadronic interactions, multiple production and processes at ultra-high energies, boson resonances, strange and nonstrange baryon resonances, collisions of charged leptons with hadrons, tests of quantum electrodynamics, meson photoproduction, weak interactions, and prospects in high energy physics. (J.F.P.)

6047 (NP-19479) ELECTROPRODUCTION EXPERIMENTS. Heinloth, Klaus (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). 1971. 92p. (In German). Dep. NTIS (U. S. Sales Only).

A group of lectures is presented, the purpose of which is to give to physics students interested in active collaboration in the high-energy field an introduction to the problems of electron scattering experiments at electron accelerators. The process of electroproduction itself is first explained. The results of electroproduction experiments done so far and the accelerators used are discussed. Examples of some typical experiments are given. The data already in hand are summarized from the point of view of future activities. (15 figures, 2 tables) (R.W.R.)

6048 QUANTUM FAMILIES AND SCALING AT HIGH ENERGIES. Apanasenko, A. V.; Baradzei, L. T.; Smorodin, Yu. A.; Solopov, E. A.; Shcherbakova, M. N. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1632-9 (Aug 1972). (In Russian).

Analysis of families of γ quanta with energies of 120 and 250 TeV showed that they were interactions E ~10^{15} eV with the formation of heavy (M_γ = 1 GeV) and ultra-heavy (M_γ = 7 GeV) clusters. Experimental proof of the existence of scaling and its source in the energy region 10^{12} to 10^{14} eV was examined. A model for which scaling was a fundamental phenomenon is discussed. (tr-auth)

6049 CHARACTERISTICS OF THE MUON AND ELECTRON COMPONENTS OF WIDE ATMOSPHERIC SHOWERS ON A MOUNTAIN TOP. Betev, B. (Inst. of Physics, Sofia); Popova, L.; Stamenov, I.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1740-3(Aug 1972). (In Russian).

Preliminary data were obtained on the fluctuations in the muon flux with $E_\mu \geq 5$ GeV in showers of given intensity. The Monte-Carlo method was employed in calculating a number of characteristics of wide atmospheric showers at mountainous elevations, assuming a two-fireball isobaric model. (tr-auth)

6050 MUON COMPONENT IN THE VICINITY OF THE AXIS OF A WIDE ATMOSPHERIC SHOWER. Il'ina, N. P.; Kalmykov, N. N.; Khrenov, B. A.; Khristiansen, G. B.; Yarochkina, Z. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1744-50(Aug 1972). (In Russian).

Muon detector data for wide atmospheric showers with various values of the parameter S were processed in order to obtain correlations in the three-dimensional distribution of muons with energies $E_\mu \geq 10$ GeV. This study included only showers with the number of total particles, N_T, = 7×10^5 to 2×10^6, in which the area of the telescope from the spark chamber (40 m^2) recorded ≥3 muons. The muon distribution of a shower at the distance r was investigated with a given number of muons on the telescope surface. These data lead to a distribution function close to the axis of the wide atmospheric shower. (K.S.W.)

6051 APPARATUS FOR STUDYING THE PHOTONUCLEAR INTERACTION OF MUONS OF HIGH ENERGIES. Aglamazov, V. A.; Gedevanishvili, L. D.; Kuridze, R. V.; (and others) (Tbilisi State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1801-2(Aug 1972). (In Russian).

Apparatus was designed for studying the energy spectrum of muons with $E \geq 10^{12}$ eV at various zenith angles for the photonuclear interaction of muons. An eight-layered ionization calorimeter with an area of 9 m^2, and its associated system of neutron counters, 10-cm Fe filters, paraffin and Pb shielding are described. (K.S.W.)

6052 ANALYSIS OF SINGLE-PION PHOTOPRODUCTION IN THE SECOND-RESONANCE REGION. Proia, A.; Sebastiani, F. (Univ., Rome). Lett. Nuovo Cim.; 5: No. 11, 748-53(11 Nov 1972).

An analysis is made of data on single-pion production from the processes $\gamma n \rightarrow p\pi^-$ and $\gamma n \rightarrow n\pi^0$ using $I = \frac{3}{2}$ multipole amplitudes. Cross sections and polarizations obtained from various solutions are presented. (L.B.S.)

6053 LOW ENERGY NUCLEONS IN WIDE ATMOSPHERIC SHOWERS. Bugaev, E. V.; Dedenko, L. G. (Inst. of Nuclear

Research, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1736-9(Aug 1972). (In Russian).

The number of low energy nucleons (recoil nucleons) was calculated for showers with a given number of particles. The resulting curves approximated the relation $N_n \sim N_T^{0.9}$, where N_n represents the number of nucleons from the total number of particles N_T. For showers with a total number of particles $N_T > 10^5$, there is agreement with experiment. For showers with $N_T < 10^5$ the calculation yields a number of nuclear-active particles below that found by experiment. (tr-auth)

6054 INVESTIGATION OF THE CHARACTERISTICS OF WIDE ATMOSPHERIC SHOWERS AT SEA LEVEL BY THE CLASSICAL METHOD AND BY RECORDING THE RADIO-RADIATION. Atrashkevich, V. B.; Vedeneev, O. V.; Kulikov, G. V.; (and others) (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1731-5(Aug 1972). (In Russian).

A comparison of experimental data on the three-dimensional distribution of muons with calculated results confirmed the existence of large transverse momenta and nuclear interactions at energies greater than several hundred GeV. Measurement of the radio-radiation of wide atmospheric showers at frequencies of 60 and 30 MHz indicated that in wide atmospheric showers there exist mechanisms of radio-radiation which differ from the geomagnetic mechanism according to the frequency spectrum. (tr-auth)

6055 ELECTROMAGNETIC CASCADES AT ENERGIES >20 GeV. Azimov, S. A.; Daudov, Z. Kh.; Kochetkov, G. A.; Kratenko, Yu. P.; Levkovich, S. G. (Tashkent State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1813-14(Aug 1972). (In Russian).

The form of cascade curves in Pb and the transition effect in Pb–brass were studied at energies >22 GeV. The apparatus consisted of a detector of electromagnetic interaction arranged above an ionization calorimeter 2.25 m^2 in area. The detector was comprised of 20 series of ionization chambers with layered Pb sheets. (K.S.W.)

6056 SPECTRUM OF OUTPUT OF WIDE ATMOSPHERIC SHOWERS AT SEA LEVEL FOR $N = 10^7$ TO 10^9 PARTICLES. Vernov, S. N.; Glushkov, A. V.; Diminshtein, O. S.; (and others) (Inst. of Space Physics Research and Aeronomics, Yakutsk, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1705-9 (Aug 1972). (In Russian).

The ratio of particle densities ρ_{sc}/ρ_g was obtained at distances of 150 to 600 m from the axis of the shower, using apparatus with an effective area of 3 km^2. The quantity ρ_{sc} = "scintillation" density, and ρ_g = the density of the charged particles in a wide atmospheric shower. One event was recorded in 6×10^3 hr with $N = 2 \times 10^{10}$. (tr-auth)

6057 CHERENKOV GLOW FROM A WIDE ATMOSPHERIC SHOWER AND THE RELATION TO SHOWER INTENSITY OF PRIMARY PARTICLE ENERGIES. Egorov, T. A.; Efimov, N. N.; Kolosov, V. A.; (and others) (Inst. of Space Physics Research and Aeronomics, Yakutsk, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1710-14(Aug 1972). (In Russian).

The spatial distribution of the flux of Cherenkov emission was measured at distances of 200 to 1000 m from the shower axis of a wide atmospheric shower. The average conversion coefficient was determined from the shower intensity as 10^7 to 10^8 particles to the initial energy at sea level. (tr-auth)

6058 EXPERIMENT ON RADIATION OF THE PULSE FORM OF CHERENKOV RADIATION AT GREAT DISTANCES FROM THE AXIS OF WIDE ATMOSPHERIC SHOWERS. Gadalov, A. N.; Efimov, N. N.; Kaganov, L. I.; (and others) (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1715-20(Aug 1972). (In Russian).

An experiment is described for studying the pulse form of the Cherenkov radiation of a wide atmospheric shower with a particle number of 3×10^6 to 3×10^8 at distances from the axis $200 < r < 500$ m. A comparison of individual events with the theory was made. The duration of the Cherenkov pulse was studied as a function of the distance to the axis of the wide atmospheric shower. (tr-auth)

6059 ENERGY SPECTRUM AND COMPOSITION OF PRIMARY COSMIC RADIATION AT ENERGIES 5×10^{13} TO 5×10^{15} eV. Aseikin, V. S.; Benko, D.; Bobova, V. P.; (and others) (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1726-30(Aug 1972). (In Russian).

Characteristics of the electron and muon components of wide atmospheric showers were investigated as originating from primary particles with energies of from 5×10^{13} to 5×10^{15} eV. The density of the electron flux was measured with 80 scintillation detectors (42 m^2) and a number of gas discharge counters with an area of 20 m^2, which were spaced at distances of up to 70 m from the center of the installation. (K.S.W.)

Weak

Refer also to abstract 5809.

6060 (LA-DC-72-847) PROGRAM OF NEUTRINO EXPERIMENTS AT LAMPF. Heller, L.; Nagle, D. E. (Los Alamos Scientific Lab., N. Mex.). 1971. 5p. (CONF-720923-1). Dep. NTIS.

From 16th international conference on high energy physics; Chicago, IL. (6 Sep 1972).

It is estimated that a 0.5-mA beam of protons at the beam dump will produce 2×10^{14} ν_e/s, with the spectrum peaking around 35 MeV. The first experiment will check whether the lepton conservation law is additive, as expressed in the decay $\mu^+ \rightarrow e^+ + \nu_e + \bar{\nu}_\mu$, or multiplicative, thereby permitting $\mu^+ \rightarrow \nu_\mu + \bar{\nu}_e + e^+$. The interaction $\nu_e + n \rightarrow p + e$ will be measured by use of D_2O in the Cherenkov counter. The cross section and angular distribution for $\nu_e + e$ scattering will be measured next. The conceptually simplest detector is liquid hydrogen, but other schemes also exist. Motivations for measuring the $\nu_e + e$ elastic cross section are given. (2 figures) (R.W.R.)

6061 MEASURING THE MEAN LIFETIME OF π^+-MESON WITH A HIGH-SPEED MULTIRAY SCOPE. Dunaitsev, A. F.; Prokoshkin, Yu. D.; Razuvaev, E. A.; Sergeev, V. A.; Simonov, Yu. N. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 16: No. 3, 524-34(Sep 1972). (In Russian).

The mean lifetime τ of π^+-mesons at rest was measured by means of a scintillation counter system and a high speed multiray scope, that was used for a multidimensional pulse height and time analysis of the $\pi-\mu$-decay events. The trap for positrons produced in a subsequent $\mu-e$-decay allowed one to reduce the background level down to 10^{-6}. The magnitude τ was found to be equal to (26.09 ± 0.08) nsec. (auth)

6062 SEARCH FOR A NEW VECTOR MESON. Clark, A. R.; Field, R. C.; Holley, W. R.; (and others) (Univ. of California, Berkeley). Lett. Nuovo Cim.; 5: No. 9, 665-71(28 Oct 1972).

In an attempt to explain the low experimental limit on the $K_L^0 \rightarrow \mu\mu$ branching ratio, it was suggested by Alles and Pati that the K_L^0 decays into a photon and a new meson (χ^0) with spin-parity $J^P = 1^-$ and mass between 350 and 425 MeV/c^2. A search is made for dielectron and dimuon decays in the interactions $K_L^0 \rightarrow \gamma\chi^0 \rightarrow \gamma e^+e^-$ and $K_L^0 \rightarrow \gamma\chi^2 \rightarrow \gamma\mu^+\mu^-$ in the suggested invariant-mass interval using a double-arm, spark chamber spectrometer. It is concluded from conservative estimates of the upper limit on the branching ratios that the χ^0 does not exist. (L.B.S.)

6063 ENERGY SPECTRUM AND ANGULAR DISTRIBUTION OF CASCADES WITH ENERGIES >0.3 TeV PRODUCED BY COSMIC MUONS. Erlykin, A. D.; Kulichenko, A. K.; Maznichenko, S. S.; Machavariani, S. K.; Meshkov, E. A. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1751-5(Aug 1972). (In Russian).

The determination of the energy spectrum and angular distribution of cascades were made at the high mountainous station FIAN, USSR with a subterranean ionization calorimeter. The data could not be interpreted within the framework of trivial representations of the mechanics of high energy muon production. Possibilities of agreement of the experimental work with that of other workers are discussed. (tr-auth)

6064 ENERGY SPECTRUM AND ANGULAR DISTRIBUTION OF COSMIC RAY MUONS WITH ENERGIES OF 2 TO 10 TeV. Amineva, T. P.; Varkovitskaya, A. Ya.; Volkova, L. V.; (and others) (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1756-60(Aug 1972). (In Russian).

An arrangement of 146 photofilm-lead sheet chambers was used at depths of five and six meters underground in a search for traces of electron-photon cascades (EPC). The zenith angle, optical density of spots, and energy of the EPC were determined. Events were recorded with an energy span of 2 to 10 TeV. (K.S.W.)

6065 NUCLEAR INTERACTION OF MUONS IN IRON. Borog, V. V.; Kirillov-Ugryumov, V. G.; Petrukhin, A. A.; Chernyatin, V. K. (Moscow Engineering-Physics Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1761-6(Aug 1972). (In Russian).

Nuclear cascades with energies $\epsilon \geq 100$ GeV were recorded in a horizontal flux of cosmic muons using an ionization chamber. Comparison of the spectrum of the nuclear cascades with that calculated

showed excellent agreement with regard to the stepwise dependence of the cross section $\sigma \sim E^{\alpha}/\epsilon$ for $\alpha = 0.1 \pm 0.1$, and was not at variance with the logarithmic increase of the cross section with muon energy over the interval 300 to 3000 GeV. Evaluation of the cross section $\sigma_{\gamma N}$ in Fe according to L. N. Hand's model (1963) yielded the value ~100 μbarns/nucleon at 100 GeV, which is practically independent of energy of the photons up to 1000 GeV. (tr-auth)

6066 INVESTIGATION OF THE MECHANISMS OF GROUP FORMATION OF PENETRATING PARTICLES BY THE SPARK CALORIMETER METHOD. Bibilashvili, M. F. (Inst. of Physics, Tbilisi, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1767-70(Aug 1972). (In Russian).

A field of correlation of impacts and average distances for particles in groups was constructed. Space–energy characteristics allowed separation of three events: muons from wide atmospheric showers, muon tridents, and events which did not admit of a trivial explanation. The experiments were related to the X-processes of J. D. Biorcen et al (1969). (tr-auth)

6067 FLUCTUATIONS OF THE SPATIAL DISTRIBUTION OF THE NUMBER OF PARTICLES IN SHOWERS GENERATED BY MUONS IN A HEAVY SUBSTANCE. Betman, R. G.; Gedalin, E. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1171-3(Aug 1972). (In Russian).

Fluctuations of the spatial distribution of electrons were studied, with consideration of the possibility of re-establishing the distribution function of the probability of the number of particles in electromagnetic showers which might be generated by muons in heavy substances. (tr-auth)

Strong (Baryon-induced)

6068 SEARCH FOR HEAVY QUASISTABLE LEPTONS. Golovkin, S. V.; Grachev, M. I.; Khodyrev, Yu. S.; (and others) (Inst. for High Energy Physics, Serpukhov, USSR). Phys. Lett.; 42B: No. 1, 136-40(13 Nov 1972).

Negative results of a search for heavy quasistable charge leptons at the IHEP accelerator are reported. For the selection of heavy leptons a system of scintillation and gas Cherenkov counters was used. The upper limit estimation of the differential cross section for heavy lepton production in pN collisions at $E_p = 70$ GeV is $d^2\delta_\lambda$ ($p = 25$ GeV/c; $\theta = 0$; $M_\lambda \geq 1$ GeV), $d\Omega dp = 1.6 \times 10^{-37}$ (cm^2/ster) GeV/c (with 90% confidence level). The results of the present work, together with the data on muon pair production in nucleon-nucleon interactions, show that in nature there are no heavy charged leptons with masses from $M_\lambda = 1.0$ GeV (with $\tau_\lambda \geq 2 \times 10^{-9}$ sec) up to $M_\lambda = 4.25$ GeV (with $\tau_\lambda \geq 4 \times 10^{-8}$ sec) and even up to $M_\lambda = 4.5$ GeV (with $\tau_\lambda \geq 4 \times 10^{-7}$ sec). (auth)

6069 MEASUREMENT OF THE Ξ^* (1530) MASS, WIDTH, AND MASS DIFFERENCE. Baltay, C. (Columbia Univ., New York); Bridgewater, A.; Cooper, W. A.; (and others). Phys. Lett.; 42B: No. 1, 129-32(13 Nov 1972).

The respective Ξ^{*0} and Ξ^{*-} masses are found to be 1532.0 ± 0.4 MeV and 1534.7 ± 1.1 MeV, the corresponding natural widths are found to be 9.0 ± 0.7 MeV and 7.8^{+3}_{-2} MeV, and the mass difference is found to be $M(\Xi^{*-}) - M(\Xi^{*0}) = 2.7 \pm 1.0$ MeV. (auth)

6070 DIFFERENTIAL CROSS SECTIONS OF 1 GeV PROTON SCATTERING FROM ^{12}C. Alkhazov, G. D.; Amalskii, G. M.; Belostotskii, S. L.; (and others) (Leningrad Nuclear Physics Inst.). Phys. Lett.; 42B: No. 1, 121-3(13 Nov 1972).

Differential cross sections are presented for elastic and inelastic (with excitation of the 4.43 MeV level) scattering of 1 GeV protons from ^{12}C in the angle range $\theta_{cm} = 10° - 30°$. The measurements were carried out with the energy resolution FWHM = 3.5 MeV. (auth)

6071 DEPENDENCE OF MULTIPLICITY ON ENERGY IN HIGH-ENERGY p–p COLLISIONS. Ganguli, S. N.; Malhotra, P. K. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett.; 42B: No. 1, 83-7(13 Nov 1972).

The available data on multiplicity of charged particles in the range 4 to 10^4 GeV/c were analysed. The following conclusions were drawn: (i) prediction of statistical and hydrodynamical model is surprisingly well borne out by the data; (ii) the prediction of isobar-pionisation type of models disagrees with the data, and (iii) assuming an asymptotic behavior of multiplicity as log s, the approach to this seems to be characterized by $s^{-\alpha}$, with $\alpha \approx 0.2 - 0.3$. (auth)

6072 INTERACTION OF TWO NUCLEONS. Moravcsik, M. J. (Univ. of Oregon, Eugene). Rep. Progr. Phys.; 35: No. 6, 587-676(1972).

Research on the two-nucleon problem during the period 1959 to 1971 is reviewed, and the status of this field is assessed. An attempt is also made to give a complete bibliography covering this period. The review was completed in August 1972. The subject is covered in sections: experiments; phenomenology (partial waves, potentials, boundary condition models, low energy phenomena, the deuteron); theory (one-particle exchange models, beyond the one-particle exchanges, the three-body problem, bremsstrahlung, pion production, tests and corrections). (UK)

6073 HADRON INTERACTION ABOVE 100 GeV WITH ATOMIC NUCLEI. Anoshin, A. I.; Bashindzhagyan, G. L.; Bel'zer, L. I.; (and others) (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1640-4(Aug 1972). (In Russian).

Hadron interactions were investigated experimentally at a high altitude station (3260 m) with an ionization calorimeter and a proportional counter with a system of hodoscopic counters. Using the proportional counter a relation was found between the most probable ionization value and the Lorentz factor for relativistic particles with a charge z. Results indicated that in nuclear reactions, starting with energies ~300 GeV, heavy, unstable particles were produced with masses ~15 to 20 GeV/c^2 with a lifetime of $\sim 5 \times 10^{-11}$ sec. (K.S.W.)

6074 MULTIPLICITY OF GENERATED PARTICLES IN INELASTIC INTERACTIONS OF NUCLEONS WITH NUCLEI OF LiH AT ENERGIES OF 150 TO 550 GeV. Zelevinskaya, N. G. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1645-8(Aug 1972). (In Russian).

The distribution according to n_s, charged-particle number was analyzed for 73 interactions of cosmic hadrons with LiH nuclei at 150 to 550 GeV. The experimental data were satisfactorily described by a Poisson distribution at $\langle n_s \rangle = 7.6$. Average characteristics were obtained for events with $n_s = 2$ to 9 and $n_s = 10$ to 19. The angular and momentum distributions of these two groups of events agree in the center-of-mass system. A decrease in γ, the fireball multiplicity, was observed with increasing n_s, conforming with a decrease of the fraction of showers with an asymmetry $|a| \geq 0.5$. (tr-auth)

6075 SOME REGULARITIES OF INELASTIC INTERACTIONS AT 10^{11} TO 10^{12} eV. Atanelishvili, M. I.; Berdzenishvili, O. L.; Verbetskii, Yu. G.; (and others) (Inst. of Physics, Tbilisi, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1649-51(Aug 1972). (In Russian).

The energy dependence of the multiplicity of particles produced for interactions by light nuclei is studied. The average multiplicity of charged particles increased logarithmically with energy. The dependence of various parameters of interaction on the multiplicity was obtained, and a strong dependence was noted on n_s, number of charged particles, of the coefficient of inelasticity and of angular distribution. (tr-auth)

6076 COLLECTIVE INTERACTIONS OF NUCLEONS OF HEAVY NUCLEI OF COSMIC RAYS OF HIGH ENERGY. Grigorov, N. L.; Zhuravlev, D. A.; Kozlov, V. D.; (and others) (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1657-60(Aug 1972). (In Russian).

An analysis was made of existing data on the generation of γ quanta of high energy by cosmic ray particles in the upper reaches of the atmosphere. The effectiveness of generation for one interaction at high altitudes was greater than at low altitudes. This was interpreted as evidence of the possibility of collective interactions of nucleon groups of nuclei impinging on the target-nucleus. Possible experiments for the direct study of the effects of collective interaction of nucleons of the nucleus were considered. (auth)

6077 GENERATION OF π^0 MESONS BY NUCLEONS AND PIONS OF HIGH ENERGY. Sobinyakov, V. A.; Tret'yakova, Ch. A.; Chikova, L. O.; Shestoperov, V. Ya. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1661-5(Aug 1972). (In Russian).

The interactions of hadrons with $E_0 > 1$ TeV were investigated (singly and in the form of an electron-nuclear shower). In both cases the identical fraction of energy of the primary hadrons was communicated to the π^0-mesons. This suggests that at high energies the interactions of nucleons and pions are practically the same from the viewpoint of energy transmission to the π^0-mesons. (tr-auth)

6078 EFFECTIVE CROSS SECTION OF INELASTIC INTERACTION OF HADRONS WITH THE NUCLEI OF LEAD ATOMS AT 3 TO 30 TeV. Aseikin, V. S.; Ershova, T. A.; Nam, R. A.; Chubenko, A. P.; Yakovlev, V. I. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1666-8 (Aug 1972). (In Russian).

The effective cross section of inelastic hadron interaction was

measured in the energy range 3 to 30 TeV, as obtained with an ionization calorimeter and a system of hodoscopic counters. (tr-auth)

6079 GENERAL CHARACTERISTICS OF PROTON–NUCLEON AND COHERENT INTERACTIONS AT AN ENERGY OF 67 GeV. Antonova, M. G. (Inst. of High Energy Physics, Alma-Ata, USSR); Boos, E. G.; Morozova, P. V.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1687-95(Aug 1972). (In Russian).

The angular distribution of secondary particles was obtained on the scale $x = \lg \operatorname{tg} \theta$ for different multiplicity groups. For pp-interactions these angular distributions were arranged in a center-of-mass system. Coherent production of π-mesons by protons on nuclei of photoemulsion was investigated: $p + A \rightarrow p + k\pi + A$ ($k = 1, 2, \ldots n$). From an analysis of distributions according to multiplicity and the angular distributions, the mean free path was evaluated with the production of one and three charged particles. An increase in the cross section of coherent production of particles was observed during an increase in energy from 20 to 70 GeV. (tr-auth)

6080 STUDY OF THE INTERACTION OF HIGH ENERGY HADRONS BY THE NUCLEAR PHOTOEMULSION METHOD. Maslennikova, N. V.; Orlova, G. I.; Tret'yakova, M. I.; Chernyavskii, M. M. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1696-1700(Aug 1972). (In Russian).

A nuclear interaction of the type $2 + 3 + 40p$ ($E_0 \sim 10^{13}$ eV) with isotropic angular distribution was analyzed and interpreted as a super-heavy fireball of mass ~20 GeV/c^2. Data on the energetic emission of π^0-mesons from π^- N-interaction at 60 GeV/c were given. The coherent reaction π^--nucleus with the production of one charged and two neutral mesons was examined. (tr-auth)

6081 COMPARISON OF THE CHARACTERISTICS OF PION–NUCLEON AND PROTON–NUCLEON INTERACTIONS. Boos, E. G.; Vinitskii, A. Kh.; Takibaev, Zh. S.; Tursunov, R. A.; Chasnikov, I. Ya. (Inst. of High Energy Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1701-4(Aug 1972). (In Russian).

From a comparison of various characteristics (asymmetry of angular distribution, momentum spectra, the distribution of four-momentum transfer) of inelastic hadron collisions (1026 events) during accelerated energies, a conclusion was reached regarding the peculiarities of πN- and pN-interactions. (tr-auth)

6082 TEST OF THE INVARIANCE OF CHARGE CONJUGATION IN ANNIHILATIONS $\bar{p} \rightarrow 3\pi^+ 3\pi^-$ AND $\bar{p}p \rightarrow 3\pi^+ 3\pi^- \pi^0$. Vuillemin, V. (Univ., Lausanne, Switzerland); Weill, R.; Gailloud, M.; (and others). Helv. Phys. Acta; 45: No. 6, 986-92(1972). (In French).

Charge conjugation was tested in $\bar{p}p$ 6-prong annihilation stars observed in bubble chamber pictures. An upper limit of $4 \cdot 10^{-3}$ for C nonconservation is established within the present statistics. (auth)

6083 DEPENDENCE OF THE CHARACTERISTICS OF NUCLEAR INTERACTIONS ON THE TOTAL ENERGIES OF ALL GENERATED PARTICLES. Emel'yanov, Yu. A.; Eremenko, Yu. A.; Takibaev, Zh. S. (Inst. of High Energy Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1815-17(Aug 1972). (In Russian).

The coefficient of inelasticity of nucleon interactions in the region 10 to 10^3 GeV is rather small; the nucleons after impact possess velocities large in comparison with the collective velocity of the motion of the mesons produced. Eighty events previously recorded with a Wilson chamber and a calorimeter were analyzed. The dependence of dispersion of the angular distribution of charged particles and the average multiplicity on the total energy of the particles generated was studied. (K.S.W.)

6084 RELATION BETWEEN THE ENERGIES OF CHARGED AND NEUTRAL PARTICLES GENERATED AT ENERGIES ABOVE 100 GeV. Emel'yanov, Yu. A.; Eremenko, Yu. A.; Takibaev, Zh. S. (Inst. of High Energy Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1823-4(Aug 1972). (In Russian).

The characteristics of nuclear interactions in dependence on the total energy $E_\pi = E_{\pi^0} + E_{\pi^\pm}$ which was transmitted to all generated particles were studied. The energies E_{π^0} and $E_{\pi^\pm}$ were determined independently with a relative error of 35 and 30%, respectively. The energies of charged and neutral secondary particles were examined as functions of their total energy and could be described by the equation $E_{\pi^0} = E_{\pi^\pm} = 0.5\, E_\pi$ up to $E_\pi^* \approx 300$ to 400 GeV. In the region $E_\pi^* > 300$ to 400 GeV the fraction of energy communicated to charged pions dropped, and the fraction of energy transmitted to neutral particle increased. (K.S.W.)

6085 INTERACTION OF PIONS AND NUCLEONS WITH CARBON AND ALUMINUM NUCLEI IN THE ENERGY RANGE FROM 30 TO 300 GeV. Avakoz, A. V.; Vasil'eva, L. F.; Vasil'ev, P. S.; (and others) (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1786-7(Aug 1972). (In Russian).

The cross section of inelastic interaction of nucleons and pions with carbon nuclei was measured. The characteristics of multiple production by Al and C nuclei were studied in the range of energies 30 to 300 GeV. Measurements from 30 to 70 GeV were conducted with an accelerator; energies >100 GeV were studied in cosmic rays with a wide-gap spark chamber. (K.S.W.)

6086 EFFECT OF MOTION OF AN S-SYSTEM ON THE CHARACTERISTICS OF THE ANGULAR DISTRIBUTION OF SECONDARY PARTICLES AT ENERGIES OF SEVERAL HUNDRED GeV. Babaev, M. K.; Eremenko, Yu. A.; Lukin, Yu. T. (Inst. of High Energy Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1788-90(Aug 1972). (In Russian).

Previous study of hadron interaction at energies >200 GeV was an aid to investigating the collective movement of particles, which may be the result of a static system of particles travelling in a center-of-mass system and disintegrating in its own system of rest. Using the predetermined angle of bundle emission, their correlations with asymmetry parameters α and β were studied. The dispersion angular distribution was determined as a function of the flight angle in the S-system. (K.S.W.)

6087 RECORDING HIGH ENERGY PARTICLE INTERACTION BY A CONTROLLED EMULSION STACK OF LARGE VOLUME. Alekseeva, K. I.; Grigorov, N. L.; Zhuravlev, D. A.; (and others) (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1795-8(Aug 1972). (In Russian).

The interaction of protons and nuclei of primary cosmic radiation with energies 10^{12} to 10^{13} eV was measured with a large stack of nuclear photoemulsion, two wide-gap spark chambers, and an ionization calorimeter. Functioning of the apparatus and analysis of the results are elucidated. (K.S.W.)

6088 DEPENDENCE OF THE CROSS SECTION OF COHERENT PRODUCTION OF PARTICLES BY PROTONS ON INITIAL ENERGIES. Takibaev, Zh. S.; Boos, E. G.; Tursunov, R. A. (Inst. of High Energy Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1799-1800(Aug 1972). (In Russian).

The dependence of coherent processes on the initial energy was evaluated from the data of Grigorov et al. (1969), on the measurement of the effective cross sections of inelastic interaction of protons with carbon nuclei in the energy region 20 to 600 GeV. (K.S.W.)

Strong (Meson-induced)

6089 COMPARISON OF THE PRODUCTION OF K* (890) IN K^+p AND K^-p INTERACTIONS. Carney, J. N. (Univ. of Birmingham, Eng.); Colley, D. C.; Jobes, M.; (and others). Phys. Lett.; 42B: No. 1, 124-8(13 Nov 1972).

Results are presented on an analysis of the reaction $K^+p \rightarrow K^{*+}$ (890) p at 16 GeV/c and compared with data at lower incident momenta and with corresponding results for the reaction $K^-p \rightarrow K^{*-}$ (890) p. It is found for both reactions that the energy dependence of the cross section exhibits a simple (p_{lab}^{-n}) behavior. (auth)

6090 $\pi^- - p$ BACKWARD ELASTIC SCATTERING BETWEEN 1.28 AND 3.0 GeV/c. Ott, R. J. (McGill Univ., Montreal); Trischuk, J.; Va'vra, J.; Richards, T. J.; Schroeder, L. S. Phys. Lett.; 42B: No. 1, 133-5(13 Nov 1972).

The differential cross section for $\pi^- - p$ elastic scattering over the angular range 125° to 178° center of mass was measured between 1.28 and 3.0 GeV/c. Considerable structure is found and is discussed in terms of direct channel resonances. (auth)

6091 $\pi^- p \rightarrow \pi^- \pi^0 p$ REACTION AT $p_{\pi^-} = 4.45$ GeV/c. Kartamyshev, A. A.; Mukhin, K. N.; Romantseva, A. S.; (and others) (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 16: No. 3, 535-8 (Sep 1972). (In Russian).

The σ_{tot} and $d\sigma/dt'$ for $\pi^- p \rightarrow \pi^- \pi^0 p$ reaction were measured with the hydrogen bubble chamber method for $p_{\pi^-} = 4.45$ GeV/c and ρ^--resonance produced in this reaction: $\sigma_{tot} = 2.1 \pm 0.3$ mb, $\sigma(\rho^-) = 0.34 \pm 0.05$ mb. Extrapolating according to Chou and Law and in the pseudoperipheral approximation the estimation for the cross section of elastic $\pi^-\pi^0$-scattering in the energy range $0.28 \leq \omega_{\pi\pi} \leq 1.5$ GeV was obtained. The value of $\sigma_{\pi\pi}$ in the ρ^--resonance region is found to equal $\sigma_{\pi\pi}(\rho^-) = 120 \pm 25$ mb, it is in agreement with the unitary bound. (auth)

6092 MOMENTUM CHARACTERISTICS OF PION–NUCLEON INTERACTIONS AT 60 GeV. Takibaev, Zh. S.; Chasnikov, I. Ya.; Vinitskii, A. Kh.; (and others). (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 16: No. 3, 539-45(Sep 1972). (In Russian).

Momentum characteristics of secondaries produced in pion-nucleon interactions in the nuclear photoemulsion are analyzed. The particle momentum characteristics are compared with the data obtained at 7.5 and 17 GeV. It is shown that the view of the momentum spectra for pions and protons in the C-system does not change greatly with the energy increase of initial E_0. Pion mean energy changes with E_0 as $E_0^{1/4}$. The experimental data are compared with hydrodynamics and multiperipheral models. (auth)

6093 POLE (IN t) PARAMETRIZATION OF SIGNATURE MULTIPLIER. OPTICAL MODEL. Dubovikov, M. S. (Moscow Physical-Technical Inst.). Yadern. Fiz.; 16: No. 3, 568-74(Sep 1972). (In Russian).

In the framework of the optical model a method to calculate a contribution of branchings in the j-plane to the amplitude was worked out. It is worked out under condition that the dependence upon transferred momenta of the Regge pole amplitude is parametrized as $e^{-\Lambda^2 t}/(M^2 + \varkappa^2)$. The general method is applied to the $\pi^- p \to \rho^0 n$ process (Reggeized OPEA model). Comparison with experimental data obtained at 15 GeV/c exhibits that $\Lambda_\pi < \Lambda_p$. This fact is in agreement with applicability of the nonreggeized OPEA model at 4 GeV/c. The possibility to widen the domain where the optical model is in accord with experimental results for all the process was pointed out for the given parametrization of Regge pole amplitudes. (auth)

6094 PION AND NUCLEON INTERACTION AT HIGH ENERGIES. Azimov, S. A.; Myalkovskii, V. M.; Nuritdinov, Kh.; (and others) (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1626-31(Aug 1972). (In Russian).

The coefficient of inelasticity $\langle K_{\pi^0} \rangle$ was weakly dependent on the atomic number of the target-nucleus for hadron interactions with $E_0 > 200$ GeV. There was also a weak dependence on the nature of the primary particle (for primary π-mesons $\langle K_{\pi^0} \rangle$ is about twice as large as for a nucleon). The dependence of $\langle n_c \rangle$, number of charged particles, on E_0 was logarithmic. The average multiplicity during pion–neutron interaction in paraffin was identical within the limits of error. An azimuthal effect for the angular distribution of secondary particles was noted. (tr-auth)

6095 ANGULAR AND MOMENTUM CHARACTERISTICS OF π^--MESON INTERACTIONS WITH AN ENERGY OF 60 GeV IN EMULSION. Alekseeva, K. I. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1818-22(Aug 1972). (In Russian).

There were found in a layered emulsion apparatus 137 showers with various numbers of black, grey, and relativistic traces, after exposure to 60-GeV π^--mesons in an accelerator. An analysis of the angular distributions of secondary particles and the momentum characteristics of the showers were made. (K.S.W.)

Particle Interactions and Properties (Theoretical)

General

6096 (CONF-700806-(Vol.2)(Absts.)) XVth INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS, KIEV, 1970. ABSTRACTS OF CONTRIBUTIONS. VOL. 2. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1970.

Abstracts in theoretical high energy physics are presented covering dynamics of two-body, quasi-two-body, and many-body processes at high energies, duality and dual models, symmetry properties in elementary particle theory, current algebra and chiral symmetry, electromagnetic and weak interactions, analytic properties of amplitudes and asymptotic theorems, and general properties of field theory. (J.F.P.)

6097 (IS–2800) HIGH-, MEDIUM-, AND LOW-ENERGY PHYSICS, MATHEMATICS AND COMPUTER, CHEMISTRY, AND METALLURGY AND MATERIALS RESEARCH. 1971 Annual Summary Report, Progress and Plans. (Ames Lab., Iowa). Nov 1972. Contract W-7405-eng-82. 138p. Dep. NTIS.

Abstracts of published experimental and theoretical research in high energy and nuclear physics, mathematics and computers, chemistry, metallurgy and materials, and solid state physics are presented. (J.F.P.)

6098 (ITF–72–96–E) FIVE-POINT DAMA. Enkovskii, L. L.; Timokhin, V. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 17p. Dep. NTIS (U. S. Sales Only).

A five-point dual amplitude with Mandelstam analyticity (DAMA) is studied. A procedure for the analytic continuation into the physical domain is suggested. (auth)

6099 (ITF–72–122–E) INCLUSIVE PROCESSES IN DAMA. Enkovskii, L. L.; Kobylinskii, N. A.; Mätynov, E. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 16p. Dep. NTIS (U. S. Sales Only).

One-particle distributions in different asymptotic regions are studied in the framework of DAMA (dual amplitude with Mandelstam analyticity). The predictions in the central region essentially differ from those obtained in NR dual models. Less important is the difference in the fragmentation region. (auth)

6100 ISOSPIN CONSTRAINTS BETWEEN THREE CROSS SECTIONS AND TWO POLARIZATION DENSITY MATRICES. Doncel, M. G.; Michel, L.; Minnaert, P. (CERN, Geneva). Phys. Lett.; 42B: No. 1, 96-8(13 Nov 1972).

The relation which isospin conservation imposes between the three cross sections and two polarization density matrices is given for three reactions related by two isospin channels. It is valid for arbitrary spin and for spin correlations. Its application to the most usual cases of spin 1 and $^3/_2$ is given. (auth)

6101 MINIMUM RADIUS OF PARTICLES WITH SPIN. Stueckelberg de Breidenbach, E. C. G. (Univ., Geneva). Helv. Phys. Acta; 45: 616-18(1972).

The minimum radius of a particle with spin is found starting from the generalized first law of relativity for the density tensor of an insulated system. (J.F.P.)

6102 FLUCTUATIONS IN ANGULAR DISTRIBUTION OF PARTICLES, PRODUCED AT HIGH ENERGIES AND BIMODALITY. Volkov, E. I. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 16: No. 3, 594-8(Sep 1972). (In Russian).

The Monte-Carlo method is used to study the problem of fluctuations in angular distribution for multiparticle production in high energy collisions. As a further development for a previous work a model is considered where the mean distribution in variables $\eta = \lg \operatorname{tg} (\theta_{SCI}/2)$ is of a mesalike structure. It is shown that taking into account the energy conservation law and smoothing of the edges of distribution in η, fluctuations do not lead to simulation of bimodal distribution in η and do not give an explanation for the minimum observed at $\eta = 0$. (auth)

6103 GENERAL FORMULATION OF DROPLET MODEL FOR HADRON DIFFRACTION. Potupa, A. S. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 107-11(1972). (In Russian).

A quantum-mechanical picture of elastic scattering of extended hadrons in the region of high energy was constructed on the basis of a generalized droplet model of Chou and Yang (1968). As an example of the oscillator bank of internal degrees of freedom, the connection between quasi-elastic channels of diffraction excitation and the spectrum of hadron states is discussed. (tr-auth)

6104 PROBLEMS IN NUCLEAR AND ELEMENTARY PARTICLE PHYSICS INVOLVING GRAVITONS. Hare, M. G.; Papini, G. (Univ. of Saskatchewan, Regina). Gen. Relativity Gravitation; 3: No. 3, 251-6(Oct 1972).

Attention is drawn to dispersion relation techniques which are useful in calculating binding energies of light nuclei, mechanical form factors of particles and nuclei, and mean mass radii. (auth)

6105 TWO-CURRENT DUAL AMPLITUDES AND FISHING-NET DIAGRAMS. Kobushkin, A. P.; Susskind, L. (Inst. for Theoretical Physics, Kiev). Lett. Nuovo Cim.; 5: No. 6, 465-9(7 Oct 1972).

The relation between the parton model of currents and the dual model of hadrons is investigated by making use of the dense planar Feynman-diagram interpretation of duality. The extrapolation between the large- and small-distance behavior is considered in the fishing-net context. (J.F.P.)

6106 PION–MUON MODEL AND IMPROVED KAON MASS RELATIONS. Tangherlini, F. R. (Coll. of The Holy Cross, Worcester, Mass.). Lett. Nuovo Cim.; 5: No. 6, 461-4(7 Oct 1972).

A previous pion–muon mass difference rule is modified to state that there exist very precise linear rational relations between the masses of the elementary particles independently of what kind, baryon, meson or lepton; these relations hold in at least one case to about 1 ppm. According to the mass relations, if one knows the masses of the proton and neutron, one can calculate the mass of the lambda. If, in addition, one knows the mass of the electron, one can go on to calculate the masses of

the charged and neutral kaon, the neutral pion, and the hyperons Ξ^0 and Ξ^+. (J.F.P.)

6107 COMMENTS ON MUELLERISM AND MEAN MULTIPLICITIES. Cahn, R. N. (Stanford Univ., CA). Lett. Nuovo Cim.; 5: No. 11, 782-4(11 Nov 1972).

The Mueller picture of inclusive reactions leads to a mean multiplicity for species c in $a + b \rightarrow c +$ anything of the form $\Delta \log s + B$. The coefficients A and B and the coefficients of the next two terms are isolated unambiguously. (L.B.S.)

6108 ATOMICS AND ELEMENTARY PARTICLES. Vandermeulen, J. (Univ., Liege). Rev. Quest. Sci.; 143: No. 3, 403-25(1972). (In French).

The dualism of atomic forces today takes on a bewildering appearance; the picture of exchange forces that present models present in consideration of the destruction in some way because the particles themselves may be the agent of the forces, being not only the carrier, but being identical with the force itself. Yet in spite of the enormous complexity of the phenomenology the search for simple principles remains the aspired goal. Bootstrap, for example, establishes the simplicity, elegance, and economy of the fundamental concepts. (tr-auth)

Electromagnetic

Refer also to abstracts 6052 and 6424.

6109 (BNL-17277) REMARKS ON LONG-RANGE BEAM-BEAM INTERACTION IN e-p COLLISIONS. Voss, G. A. (Brookhaven National Lab., Upton, N. Y.). 29 Sep 1972. 5p. Dep. NTIS.

The linear $\Delta\nu$ shift in crossing beams is considered for long-range e + p collisions. (J.F.P.)

6110 (CNRS-CPT-72-P-465) INVARIANT AMPLITUDES FOR COMPTON SCATTERING OF OFF-SHELL PHOTONS ON POLARIZED NUCLEONS. Perrottet, M. (Centre National de la Recherche Scientifique, Marseilles (France). Centre de Physique Theorique). Jun 1972. 35p. Dep. NTIS (U. S. Sales Only).

A set of 18 invariant amplitudes free from kinematic singularities in ν and t (ν is proportional to the incoming photon energy in the laboratory system; t is the square of the momentum transfer) for Compton scattering of off-shell photons by polarized nucleons is described. Special cases related to the forward and the non-forward scattering limits are discussed. (France)

6111 (FRNC-TH-214) RADIATIVE CORRECTIONS FOR STORAGE RING EXPERIMENTS. Bonneau, Guy (Paris Univ., Orsay (France). Faculte des Sciences). 1971. 119p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Formulas used in the photons exchange approximation for calculating radiative corrections for the $e^+e^- \rightarrow f = B\bar{B}$ reaction (B = boson without spin) are presented. The calculation is effected at the third order of α. The expression for the radiative corrections due to the photon emitted by the initial lines is established. The cross section for the bremsstrahlung is calculated together with the fourth-order-in-e Feynman renormalization diagrams. The expression for the radiative corrections due to the photon emitted by the final lines corresponding to bosons without spin (π^{+-},K^{+-}) is calculated; the bremsstrahlung cross section (infrared divergence) was investigated. The fourth-order-in-e renormalization diagrams are studied using the dispersion relations. The phase spaces of the final particles were determined within the limits imposed by the experimental equipment. Numerical results are given, the Gounaris-Sakurai model being used to calculate the form factors of the charged mesons. (France)

6112 (ITF-72-119-E) TWO CURRENT DUAL AMPLITUDES AND FISHNET DIAGRAMS. Kobushkin, A. P.; Susskind, L. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 10p. Dep. NTIS (U. S. Sales Only).

Two-current amplitudes are studied in the framework of the fishnet diagram approach. Nonphysical singularities are removed by a corresponding cutoff. (auth)

6113 (N-72-22695) MEDIUM-TO-MEDIUM TRANSITION RADIATION AND DETECTION OF ULTRARELATIVISTIC CHARGED PARTICLES. Robbins, D. E.; Mack, J. E. (National Aeronautics and Space Administration, Houston, Tex. Manned Spacecraft Center). Mar 1972. 11p. (NASA-TM-X-58083; MSC-4565). NTIS.

The use of x-ray transition radiation to distinguish between protons and positrons of equal rigidity was investigated. A formula for the transition radiation spectrum from a medium-to-medium boundary was derived. The formation zone effect was found to limit the detection of transition radiation from ultrarelativistic particles. Curves showing the results of the spectrum calculations are presented. (auth) (STAR)

6114 NEUTRON POLARIZABILITY AND THE n-e SCATTERING LENGTH. Bernabeu, J.; Ericson, T. E. O. (CERN, Geneva). Phys. Lett.; 42B: No. 1, 93-5(13 Nov 1972).

It is shown that the neutron polarizability contribution to the n-e scattering length is within the present level of precision. The experimental result on this interaction is consistent with a value of the neutron polarizability similar to the proton one. (auth)

6115 PSEUDOSCALAR MESON DECAYS INTO LEPTON PAIRS AND THE LEE-WICK THEORY. Bramon, A. (CNEN, Frascati, Italy). Phys. Lett.; 42B: No. 1, 99-102(13 Nov 1972).

The branching ratios $R_{P\rightarrow ll} \equiv \Gamma(P \rightarrow ll)/\Gamma(P \rightarrow \gamma\gamma)$ are evaluated using the Lee and Wick theory of QED and assuming that the $f_{P\gamma\gamma}$ couplings are independent of the photon masses. From the experimental value $R_{\eta\rightarrow\mu^+\mu^-} = (5.9 \pm 2.2) \times 10^{-5}$ one obtains $m_B = 32^{+40}_{-8}$ GeV and $R_{\pi^0\rightarrow e^+e^-} = (2.2 \pm 0.4) \times 10^{-7}$. (auth)

6116 ELECTROMAGNETIC MASS DIFFERENCES. Majumdar, D. P.; Stern, J.; Tomozawa, Y. (Univ. of Michigan, Ann Arbor). Phys. Lett.; 42B: No. 1, 103-7(13 Nov 1972).

In Cottingham's approach to electromagnetic masses (δm) one encounters the problem of unknown subtractions in the fixed mass dispersion relations for the virtual Compton scattering amplitude. This problem is avoided and δm is expressed in terms of measurable quantities, assuming knowledge of light-cone singularities of the electromagnetic current commutator. (auth)

6117 PITCH CORRECTION IN (g-2) EXPERIMENTS. Farley, F. J. N. (CERN, Geneva). Phys. Lett.; 42B: No. 1, 66-8 (13 Nov 1972).

The pitch correction to the $(g - 2)$ precession frequency of the electron or muon, arising from the axial oscillations of the particle rotating in an almost uniform magnetic field, is computed in a new way and extended to the case of axial focusing by electric fields. The main results are confirmed by a direct physical argument. (auth)

6118 EFFECT OF NEUTRON POLARIZABILITY IN NEUTRON-ELECTRON SCATTERING. Brown, L. S. (Univ. of Washington, Seattle); Harun-Ar-Rashid, A. M. Phys. Lett.; 42B: No. 1, 111-13(13 Nov 1972).

As the electron mass vanishes, the neutron-electron scattering length diverges logarithmically, with a coefficient uniquely determined by neutron polarizabilities. In view of the very large neutron-electron mass ratio, this logarithmic term must dominate the two-photon contribution to the scattering length. This correction is well below the present level of experimental precision. (auth)

6119 BJORKEN SCALING AND THE PARTON MODEL. Parisi, G. (CNEN, Frascati, Italy). Phys. Lett.; 42B: No. 1, 114-16(13 Nov 1972).

In the framework of renormalized quantum field theory it is proved under a technical assumption that Bjorken scaling in deep inelastic electron proton scattering implies the validity of the parton model. (auth)

6120 PROBABILITY OF THE NONRELATIVISTIC PARTICLE SPIN ROTATION IN THE NONUNIFORM MAGNETIC FIELD. Matora, I. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 3, 624-7(Sep 1972). (In Russian).

A quantum-mechanical equation is solved for the spin wave functions of nonrelativistic microparticles with spin $\hbar/2$ in the arbitrarily varied magnetic field H in mobile coordinate system which axis 0z is always directed along the total vector H while rotations have an angular velocity of the rotation vector H. Some estimations are given. (auth)

6121 TWO-PHOTON EXCHANGE IN SCATTERING OF HIGH ENERGY ELECTRONS AT LARGE ANGLES BY LIGHT NUCLEI. Boitsov, V. N.; Kondratyuk, L. A.; Kopeliovich, V. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 3, 515-23(Sep 1972). (In Russian).

A contribution of two-photon exchange in high energy electron scattering on ^{3}He and ^{4}He nuclei at large angles was calculated in the framework of the theory of potential multiple scattering. It is shown that in the region of the form factor minimum the relative contribution of the two-photon correction to the elastic scattering cross section reaches 30 to 40%, and it is necessary to take it into account so as to select out of experimental data the effects connected with the nucleus structure at distances, small in comparison with the size of nucleus. (auth)

6122 SOME CONSEQUENCES FROM MICROCAUSALITY FOR THE MATRIX ELEMENT OF $\langle p \mid [A(x)B(0)] \mid p \rangle$ COMMU-

TATOR. Geshkenbein, B. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 3, 608-13(Sep 1972). (In Russian).

Properties of a spectral function for the matrix element from the commutator of two operators $f(x) = \langle p|[A(x)B(0)]|\rangle$ that follow from microcausality are investigated. An equation was obtained, which should be satisfied by a spectral function so that f(x) satisfies microcausality conditions. The results obtained may be applied to the function $W_1(\nu,q^2)$ and $W_2(\nu,q^2)$ that describe an electroproduction process. (auth)

6123 CRITICAL TEST OF S-CHANNEL HELICITY CONSERVATION IN COMPTON SCATTERING. Biyajima, M. (Osaka Univ.). Lett. Nuovo Cim.; 5: No. 6, 458-60(7 Oct 1972).

It is proposed that the energy dependence of polarization data is useful for deciding the correct mechanism in Compton scattering. Since the energy dependence of the polarization is sensitive to the exchanged mesons (or Regge poles), it can be checked. The gauge-invariant Compton scattering from a spin-$\frac{1}{2}$ target is considered. The s-channel helicity is also considered. The explanations of gauge-invariant 0^+-meson exchange and spin independence are given. (J.F.P.)

6124 APPLICATION OF CUTKOSKY–DEO METHOD TO A DETERMINATION OF THE PION–NUCLEON COUPLING CONSTANT FROM PION PHOTOPRODUCTION. Schwela, D. (Univ., Bonn). Lett. Nuovo Cim.; 5: No. 6, 453-7(7 Oct 1972).

In order to explore the Cutkosky–Deo method for pion photoproduction an attempt is made to extract the coupling constant from the π^+ differential cross section data at various photon energies between 240 and 750 MeV. (J.F.P.)

6125 IS THE ADLER SUM RULE FOR INELASTIC LEPTON–HADRON PROCESSES CORRECT? Bjorken, J. D. (Stanford Linear Accelerator Center, CA.).; Tuan, S. F. Comments Nucl. Particle Phys.; 5: No. 3, 7108(May 1972).

It is stated that the recent series of Stanford-MIT experiments on inelastic electron scattering from protons and neutrons has generated great interest in the ranks of high energy particle theorists, one reason being the regularity seen in the data; there is a simple scaling property inviting a simple explanation; another reason is the relatively large cross section for production of secondary electrons of high transverse momentum. The present communication discusses the scaling property from the point of view of the sum rule of Adler for neutrino processes (Phys. Rev. B 143: 1144 (1966), based on the local current algebra proposed by Gell-Mann. From the data it is found that it is not at all evident that the sum rule will in fact be true; it will be tested in the next generation of neutrino experiments at the National Accelerator Laboratory. If it fails much of the existing theoretical superstructure would collapse, and the alternatives if the Adler sum rule were to fail are considered. It may be that the rule works only when very massive hadron states (quarks?) are included in the sum. 7 references. (UK)

6126 PHOTON–PHOTON COLLISION AND STRONG-INTERACTION CORRECTION. Bose, S. K. (Utkal Univ., India). Lett. Nuovo Cim.; 5: No. 9, 662-4(28 Oct 1972).

The cross section for the process $\gamma + \gamma \rightarrow \pi^+ + \pi^-$ is calculated using effective Lagrangians in the $K_2(SU(2) \times SU(2))$ nonlinear model, in order to study the two-photon mechanism of lepton and hadron production in e^+e and ee colliding-beam interactions. (L.B.S.)

6127 ANSWER TO THE COMMENTS OF FARAGO ON THE MEASURABILITY OF THE ELECTRON SPIN. Kalckar, J. (Niels Bohr Inst., Copenhagen). Lett. Nuovo Cim.; 5: No. 9, 645-6(28 Oct 1972).

Some points in regard to comments made by Farago (Lett. Nuovo Cimento, 4: 991(1972)) on the possibility of determining the spin of a free electron by an angular-momentum measurement are elaborated. (L.B.S.)

6128 CASCADES INITIATED BY HEAVY NUCLEI. Jones, W. V. (Louisiana State Univ., Baton Rouge). Trans. Amer. Nucl. Soc.; 15: No. 2, 968-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6129 GENERAL THRESHOLD RELATION BETWEEN DEEP INELASTIC ELECTRON SCATTERING AND DEEP INELASTIC ELECTRON–POSITRON ANNIHILATION. Gatto, R. (Univ., Rome); Menotti, P.; Vendramin, I. Lett. Nuovo Cim.; 5: No. 11, 754-6(11 Nov 1972).

It is shown that a general threshold relation exists between the scaling functions for $e + p \rightarrow p +$ anything and $e^+ + e^- \rightarrow p +$ anything interactions. (L.B.S.)

6130 PHOTON PROPAGATION IN A MAGNETIC FIELD. Constantinescu, D. H. (Scuola Normale Superiore, Pisa, Italy). Lett. Nuovo Cim.; 5: No. 11, 766-8(11 Nov 1972).

Photon propagation in a constant homogeneous magnetic field is investigated below the threshold for pair production, when dispersion is due to vacuum polarization only. The significant conclusions about the magnetic field and frequency dependence of the refractive indices are summarized. (L.B.S.)

6131 CONTRIBUTION TO SIXTH-ORDER ELECTRON AND MUON ANOMALIES. II. Barbieri, R. (Scuola Normale Superiore, Pisa, Italy); Caffo, M.; Remiddi, E. Lett. Nuovo Cim.; 5: No. 11, 769-73(11 Nov 1972).

The sixth-order contributions to the electron and muon anomalous gyromagnetic ratios are evaluated analytically from Feynman graphs. The calculation is based on systematic use of the program Schoonship for handling all algebra, on Nielson functions theory, and on dispersive techniques. (L.B.S.)

6132 MECHANISM GENERATING BOTH REGGE ASYMPTOTIC AND BJORKEN SCALING BEHAVIOR. Yang, T. C. (Univ. of California, San Diego, La Jolla). Lett. Nuovo Cim.; 5: No. 11, 777-81(11 Nov 1972).

It is pointed out that deep inelastic electron scattering cross section can be determined from the commutator of the electromagnetic currents which, by unitarity, is related to the absorptive part of forward current (virtual photon)–hadron scattering. An example is given of a simple structure of the commutator, using the light-cone commutator approach, which yields both the high-energy Regge asymptotic behavior and the scaling property in the Bjorken limit. (L.B.S.)

6133 PARTON CLUSTERS AND ORDER PARAMETERS. Knoth, A. (Univ., Rio de Janeiro). Lett. Nuovo Cim.; 5: No. 11, 785-7(11 Nov 1972).

Deep inelastic electron proton scattering is treated in a model where the partons are replaced by clusters of partons. Using the impulse approximation the same result is obtained for the clusters; the only important modification required is that one considers the probable fragmentation of the clusters during an interaction. (L.B.S.)

6134 BEHAVIOR OF THE SPATIAL DISTRIBUTION FUNCTION OF SHOWER PARTICLES IN THE VICINITY OF THE AXIS OF A CASCADE SHOWER. Guzhavin, V. V.; Ivanenko, I. P.; Roganova, T. M. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1774-8(Aug 1972). (In Russian).

A spatial distribution function of shower electrons with energies greater than E was obtained from approximation A of three-dimensional cascade theory. The electrons penetrated to a depth t in a circle of radius R from the shower axis and possessed a total energy E_0. A comparison with corresponding functions was made, which were calculated in an "axial" approximation. The error in measuring the energy E_0 was evaluated by the axial approximation method in dependence on the ratio E_0/E, the depth, and the radiation unit of length. (tr-auth)

6135 THREE-DIMENSIONAL THEORY OF DEVELOPMENT OF AN ELECTROMAGNETIC CASCADE IN THE ATMOSPHERE. Guzhavin, V. V.; Ivanenko, I. P.; Kirillov, A. A.; Paskhalov, Yu. I. (Radiotechnical Inst., Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1179-83(Aug 1972). (In Russian).

The effect of the finite character of the energy E_0 of a particle which forms a shower, on the spatial distribution function of electrons was investigated for a homogeneous medium. The radial distribution function of electrons was calculated for an isothermal atmosphere allowing for the change in the density and depth of shower origin. (tr-auth)

Weak

Refer also to abstract 6219.

6136 (ITF-72-82-P) $1^- + 1^+ \rightarrow \nu + \bar{\nu} + \gamma$ PROCESSES IN A GENERAL SCHEME OF THE WEAK NEUTRINO-LEPTON INTERACTIONS. Rekalo, A. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

The differential cross sections of the process $1^- + 1^+ \rightarrow \nu + \bar{\nu} + \gamma$ and the azimuthal asymmetry for the angular distribution of γ-quanta due to polarization of one of the initial leptons are calculated in the scheme of a general weak four-fermion (derivative-free) interaction. The polarization parameters of the γ-quanta are obtained. The sensitivity of the different observables for the $1^- + 1^+ \rightarrow \nu + \bar{\nu} + \gamma$ process to possible variants of the weak (ll) $(\nu\nu)$-interaction is analyzed. (auth)

6137 ELASTIC NEUTRINO SCATTERING IN RENORMALIZABLE THEORIES OF WEAK AND ELECTROMAGNETIC INTERACTIONS WITHOUT NEUTRAL CURRENTS. Bouchiat, C.; Iliopoulos, J.; Meyer, Ph. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Lett.; 42B: No. 1, 91-2(13 Nov 1972).

The amplitude for elastic neutrino scattering is computed to the second order, in renormalizable models of weak and electromagnetic interactions without neutral currents. The effects are shown to be of order $\sim G\alpha$. (auth)

6138 RADIATIVE DECAYS $\pi(K) \rightarrow l\nu_l\gamma$. Bardin, D. Yu.; Bilen'kii, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 3, 557-67(Sep 1972). (In Russian).

Decays $\pi(K) \rightarrow l\nu_l\gamma$ were treated in detail. The dependence of form factors on squared momentum of leptonic pair Q^2 was taken into account. It is shown that if positron and photon spectra were measured under the condition that the angle between their momenta is larger than some value, in the case of $\pi^+ \rightarrow e^+\nu_e\gamma$ decay, it would allow one to determine the parameter γ unambiguously (ratio of axial and vector form factors) as well as to check CVC hypothesis. It is shown that in $K \rightarrow l\nu_l\gamma$ decays the Q^2 dependence of form factors should be taken into account. Measuring the spectra one could obtain information about all the parameters that characterize the amplitude of these processes. The longitudinal polarization of the lepton was calculated. (auth)

6139 ELECTROMAGNETIC AND WEAK INTERACTIONS OF NEUTRINO AND $l^- + l^+ \rightarrow \nu + \bar{\nu} + \gamma$ PROCESS. Rekalo, A. P. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 16: No. 3, 554-6(Sep 1972). (In Russian).

Formulas for differential cross sections of the $l^- + l^+ \rightarrow \nu + \bar{\nu} + \gamma$ process with polarized photons are obtained, where the contributions of weak V—A-interaction and possible electromagnetic interaction of neutrino were taken into account. The sensitivity of different characteristics of the processes measured for the contributions of the mechanism studied were analyzed. (auth)

6140 μ^--MESON PRODUCTION IN $\nu\mu + N \rightarrow \mu^- + W^+ + N'$ PROCESS WITH ACCOUNT FOR NEUTRINO ENERGY SPECTRUM. Makeev, V. V.; Nevskii, P. L.; Nikitin, Yu. P.; Rozhnov, G. V.; Sokolov, A. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 16: No. 3, 546-53(Sep 1972). (In Russian).

Total and differential cross sections for μ^--mesons produced in $\nu_\mu + N \rightarrow \mu^- + W^+ + N'$ process were calculated for the mass of W-boson 3, 4, 5, 6 GeV and total magnetic moments 0, 1, 2. The contribution of "quasielastic," coherent and deep inelastic mechanisms of W-boson production on nucleon or nucleus were taken into account. All these contributions are averaged for the neutrino energy spectrum of the IHEP neutrino beam channel. Physical peculiarities of different reaction mechanisms and kinematic characteristics of μ^--meson and W^+-boson are discussed. (auth)

6141 EFFECT OF A NEUTRINO–PHOTON INTERACTION ON THE SOLAR-NEUTRINO FLUX. Perkins, W. A. (Univ. of California, Berkeley). Lett. Nuovo Cim.; 5: No. 9, 672-4(28 Oct 1972).

The solar-neutrino experiments of Davis et al. concerning the reaction $\nu + {}^{37}Cl \rightarrow {}^{37}A + e^-$ indicate that the solar-neutrino flux reaching the Earth is about a factor of 10 lower than predicted by the best calculations. The neutrino-photon cross section required to reduce the high-energy solar-neutrino flux by a factor of 10 is estimated to be $>10^{-32}$ cm^2. A direct experimental test using neutrinos from a reactor and a dense photon target such as a laser is suggested. (L.B.S.)

6142 HIGHER-ORDER CORRECTIONS TO WEAK PROCESSES. Horvath, Z.; Pocsik, G. (Roland Eoetvoes Univ., Budapest). Lett. Nuovo Cim.; 5: No. 6, 449-52(7 Oct 1972).

The conventional V–A four-fermion interaction is assumed, and the corrections in the field-theoretic perturbation theory, which is valid below the unitarity limit, are treated. Elastic $\bar{\nu}_e + e$ and $\nu_e + e$ are considered as examples. (J.F.P.)

6143 NEUTRAL CURRENT, OR HEAVY LEPTONS. Lee, B. W. (State Univ. of New York, Stony Brook). Comments Nucl. Particle Phys.; 5: No. 3, 65-9(May 1972).

A discussion is presented on the high energy behavior of some typical weak interactions from the S-matrix viewpoint and some of the conditions that a finite or renormalizable model of unified weak and electromagnetic interactions of particles must satisfy are deduced. The experimental implications of such conditions are considered. Research was based on a lepton model that unifies electromagnetic and weak interactions in a Yang-Mills gauge theory and in which the observed dissimilarities between these two interactions and, in particular, the mass of weak vector bosons, are attributed to a spontaneous breakdown of the gauge symmetry (see Weinberg, Phys. Rev. Lett 13: 1264 (1967)). Recent interest has been due to the observation of Hooft (Nuclear Phys. B. 35: 167 (1971)) who gave a compelling argument that theories of the kind considered by Weinberg are renormalizable and physically satisfactory, in the sense that the unitarity of the S-matrix is preserved. It is believed that such theories, when properly constructed, are finite in all orders of perturbation theory after renormalization. The validity of quantum electrodynamics and the proposition that observed weak interactions, such as μ- and β-decays, are mediated by charged vector bosons $W^\pm$ coupled to charged weak currents is accepted. It is found that a renormalizable model of weak interactions must contain one or both of the following two features: neutral current, requiring a neutral vector boson Z which couples to it; and heavy leptons. Experimental consequences of these two possibilities are considered. 9 references. (UK)

6144 NEUTRINO ANNIHILATION OF A LEPTON–ANTILEPTON PAIR. Yakh'yaev, R. Sh. Soobshch. Shemakhinskoi Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 6, 51-8(1971). (In Russian).

One of the most important problems in the physics of weak interactions is the direct detection of neutrino-lepton interactions. The process of annihilation of a lepton-antilepton pair by a neutrino-antineutrino pair was investigated. (K.S.W.)

6145 $K_L \rightarrow 2\mu$ DECAY. Dolgov, A. D.; Zakharov, V. I.; Okun, L. B. (Inst. of Theoretical and Experimental Physics, Moscow). Usp. Fiz. Nauk; 107: No. 4, 537-57(Aug 1972). (In Russian).

A review is presented of the possible explanations of the $K_L \rightarrow 2\mu$ decay, and of the contradiction between theory and experimental values. Some of these explanations are refuted on the basis of tests and carefully organized experiments. If the $K_L \rightarrow 2\mu$ problem does not arise from experimental errors, then the most plausible explanation is the existence of a novel interaction between K-mesons and muons. The conservative theory of the $K_L \rightarrow \mu^+\mu^-$ decay, new interactions, new elementary particles, and new violations of fundamental principles are explored. 32 references. (K.S.W.)

Strong (General)

6146 (ITF-72-99-E) NARROW RESONANCE AND "TACHYON" APPROXIMATIONS OF THE SCATTERING AMPLITUDE. Burgii, A. I.; Enkovskii, L. L.; Kobylinskii, N. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 10p. Dep. NTIS (U. S. Sales Only).

The possibility of the utilization of DAMA as input amplitude in the S-matrix theory is studied. It is shown that contrary to the Veneziano amplitude with linear trajectories which is a narrow resonance approximation (NRA) DAMA with square root trajectories is a super broad resonance approximation (SBRA). (auth)

6147 NEW TESTS OF MULTIPARTICLE PRODUCTION MODELS. Webber, B. R. (CERN, Geneva). Phys. Lett.; 42B: No. 1, 69-74(13 Nov 1972).

The two quantities known in statistical theory as the median and modal multiplicities form a better basis than the multiplicity moments for tests of multiparticle production models, and distinguish clearly between multiperipheral and diffractive models. The data indicate multiperipheral dominance. (auth)

6148 REGGE POLE MODEL. Drechsler, W. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Naturwissenschaften; 59: No. 8, 325-36(Aug 1972). (In German).

The Regge pole model for physical high-energy collision processes is described. The so-called crossing properties of scattering amplitudes are discussed and a derivation of the Regge pole expansion is presented. The typical features of the conventional Regge pole model are discussed and the complications due to Regge cuts are briefly mentioned. Finally, an account is given of the classification of strongly interacting particles and resonances into families placed on linearly rising Regge trajectories. (auth)

6149 FRACTIONAL PARENTAGE DECOMPOSITION OF THE BARYONIC QUARK STATES. Chu, S. I.; Chen-Tsai, C. T. (National Tsing Hua Univ., Hsinchu, Taiwan). Chin. J. Phys. (Taiwan); 10: No. 2, 98-109(Oct 1972).

The procedure for decomposing the symmetric three-quark $SU(6) \times O(3)$ basis states of baryons into vector products of the two-quark $SU(6) \times O(3)$ basis states and the one-quark states is elaborated and the relevant "coefficients of fractional parentage" in the decompositions are listed. Some applications of the decomposition to the evaluation of the matrix elements of the matrix elements of one-body and two-body quark operators are illustrated. (auth)

Strong (Baryon No. = 0)

6150 (COO-3533-4) PARTICLE PRODUCTION IN ANNIHILATION PROCESSES. I. BARYON NUMBER. Amann, R. F. (Syracuse Univ., N. Y. Dept. of Physics). Aug 1972. 31p. (SU-4205-4). Dep. NTIS.

The importance of annihilation processes as clean tests of models for particle production is stressed. Multiperipheral concepts are used to derive successful sum rules for annihilation cross sections and their accompanying inclusive distributions. These sum rules allow Feynman scaling and the Mueller Regge analysis to be carried over into the annihilation channel. They are further utilized to define a no parameter multiperipheral model for baryon number annihilation. This model is shown to provide a remarkably successful description of the gross features of the annihilation process from annihilations at rest up to the highest explored energies. (auth)

6151 (COO-3533-5) LOWER BOUNDS FOR $\pi-\pi$ PARTIAL-WAVE AMPLITUDES. Rupertsberger, H. W. (Syracuse Univ., N. Y. Dept. of Physics). Sep 1972. 7p. (SU-4205-5). Dep. NTIS.

Lower bounds for the $l \geq 2$ $\pi^0\pi^0 \rightarrow \pi^0\pi^0$ and $\pi^+\pi^- \rightarrow \pi^0\pi^0$ partial-wave amplitudes are derived. These bounds are dependent on the $\pi^0\pi^0 \rightarrow \pi^0\pi^0$ and $\pi^0\pi^+ \rightarrow \pi^0\pi^+$ scattering amplitudes respectively in the unphysical region. To obtain these inequalities the analytic function approach by Okubo is used. (auth)

6152 (NP-19593) CORRECTIONS TO WEINBERG'S PION-PION SCATTERING LENGTHS. Grassberger, P. (Bonn Univ. (West Germany). Physikalisches Institut). Sep 1972. 17p. Dep. NTIS (U. S. Sales Only).

Twice subtracted dispersion sum rules are derived for the $\pi\pi$ scattering lengths. The subtraction constants are the Weinberg values, and the dispersion integrals yield small corrections in good agreement with other authors. (auth)

6153 (NP-19594) CROSSING SUM RULES AND HIGH-ENERGY BOUNDS. Grassberger, P.; Kuehnelt, H. (Bonn Univ. (West Germany). Physikalisches Institut). Sep 1972. 13p. Dep. NTIS (U. S. Sales Only).

Exact energy-averaged high energy bounds for total $\pi\pi$ cross sections are given which do not depend on the d-wave scattering lengths. Instead, the low-energy input is, essentially, the properties of the f^0-meson. The starting point is rigorous sum rules for the physical absorptive parts, following from crossing and analyticity. Except at rather low energies, these bounds are much tighter than the best previous ones. (auth)

6154 NEW MEASUREMENT OF THE $\omega(784)$ WIDTH. Brown, R. M. (Univ. of Illinois, Urbana); Downing, R. W.; Holloway, L. E.; (and others). Phys. Lett.; 42B: No. 1, 117-20(13 Nov 1972).

A measurement of the $\omega(784)$ decay width was performed using a neutron counter missing mass spectrometer. A value of $\Gamma_\omega = (7.7 \pm 1.0)$ MeV is obtained. The quoted error does not include systematic errors. (auth)

6155 DECAY OF AN UNSTABLE PARTICLE. Sinha, Kalyan (Univ., Geneva). Helv. Phys. Acta; 45: 619-28(1972).

It is shown that the absence of regeneration of the unstable particle from the decay products is inconsistent with a Hamiltonian bounded below. Consequences of some decay laws are also derived. (auth)

6156 FACTORIZABLE DUAL-RESONANCE MODELS WITHOUT TACHYONS. Sukhatme, U.; Yu, S. (Univ. of Washington, Seattle). Lett. Nuovo Cim.; 5: No. 6, 513-16(7 Oct 1972).

Two new factorizable dual resonance amplitudes with no tachyons and no ghosts on the leading trajectory are proposed. These amplitudes are obtained by making simple modifications of conventional dual amplitudes. The scattering of spinless particles is considered. (J.F.P.)

6157 SLOPE PARAMETER OF DIFFRACTION PEAK IN ELASTIC SCATTERING. Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 5: No. 6, 490-4(7 Oct 1972).

The properties of the slope parameter of the diffraction peak in elastic $\pi + p$, $p + p$, and $\bar{p} + p$ scattering are studied on the basis of the dual absorptive model. It is shown that the characteristic feature of the slope parameter mainly comes from the sign of IM $R_{++}(t = 0)$ and the magnitude of $\alpha_{P'}$, where $R_{++}(t)$ is the helicity-nonflip amplitude due to the $R(\rho, \omega, A_2,$ and $P')$ trajectories. (J.F.P.)

Strong (Baryon No. = 1)

6158 (JINR-P4-6644) $\pi N \rightarrow \pi\pi N$ REACTION AMPLITUDES NEAR THE THRESHOLD WITH THE ACCOUNT OF THE THIRD ORDER TERMS OVER RELATIVE MOMENTA OF FINAL PARTICLES. Volkovitskii, P. E.; Gulkanyan, G. R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

Within the framework of semiphenomenological theory on production of three particles near the threshold there were calculated the amplitudes of diagrams contributing the cubic terms into the $\pi N \rightarrow \pi\pi N$ reaction amplitudes. The ratios are presented for the amplitudes of different channels allowing their joint processing to be performed. The third order terms, included into the matrix element square, are calculated for the channel $\pi^-p \rightarrow \pi^+\pi^-n$. The formulas obtained can be used for determination of the $\pi\pi$-scattering length. (auth)

6159 (SLAC-Trans-147) RELATION BETWEEN THE SLOPES OF THE DIFFRACTION PEAKS OF FORWARD AND BACKWARD HIGH-ENERGY SCATTERING. Arkhipov, A. A.; Savrin, V. I. Translated for Stanford Linear Accelerator Center, Calif., from report IFVE-STF-71-107. 9p. Dep. NTIS.

The connection between the reciprocal widths of peaks in the angular distribution for backward and forward scattering is found explicitly allowing for the symmetry properties of the scattering amplitude and within the framework of a previous approach. The reactions $\pi^+ + p$, $\pi^- + p$, $K^+ + p$, and $K^- + p$ at high energies are considered. (J.F.P.)

6160 (YALE-3075/4) CORRELATIONS IN HIGH-ENERGY PRODUCTION PROCESSES. Berger, E. L. (Argonne National Lab., Ill.); Jacob, M. (National Accelerator Lab., Batavia, Ill.); Slansky, R. (Yale Univ., New Haven, Conn. Dept. of Physics). Mar 1972. Contract AT(11-1)-3075. 58p. (ANL/HEP-7211; NAL/THY-45). Dep. NTIS.

Rapidity distributions for two particle inclusive reactions are calculated from the Nova model which has been successful at reproducing the single particle distributions. Particular attention is given to the $2\pi^-$ correlations in $\pi^\pm p$ and pp collisions for which data are available. Good agreement with data provides further evidence for a strong clustering of secondaries in particle production at present machine energies, a feature inferred previously from the analysis of single particle distributions. The importance of measuring the energy dependence of $\langle n(n-1)\rangle$, the quantity which normalizes the two particle distribution, is stressed. A number of other features of correlation experiments are discussed. General properties of particle production are emphasized in reviewing the Nova model. (auth)

6161 RELATION BETWEEN THE COUPLING CONSTANTS $KN\Lambda$, $KN\Sigma$ AND BOUNDS ON THEM. Dumbrais, O. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 3, 599-602(Sep 1972). (In Russian).

New relations between the coupling constants $KN\Lambda$, $KN\Sigma$ as well as upper bounds for their values were obtained. (auth)

6162 ABSORPTION MODEL AND SPIN PARITY OF B-MESON. Guzhavin, V. M.; Dubovikov, M. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 3, 575-8(Sep 1972). (In Russian).

In the framework of OMEA model the cross section for $\pi^-p \rightarrow B^-p$ reaction was derived for spin-parity values of B-meson $J^P = 1^+, 2^+$. Only the hypothesis $J^P = 1^+$ is in accord with experimental data. The problem of applicability of OMEA model is discussed. (auth)

6163 PARAMETRIZATION OF pi π^-p SCATTERING EXPERIMENTS. Rasche, G. (Univ., Zurich); Woolcock, W. S. Helv. Phys. Acta; 45: 642-53(1972).

The difficulty of making a precise statement of charge independence for pion-nucleon scattering is pointed out. It is emphasized that in taking account of electromagnetic effects in the analysis of π^-p scattering experiments, it is necessary to consider the radiative capture process $\pi^-p \rightarrow \gamma n$. A procedure for doing this is given. The unsatisfactory aspects of recent statements about time-reversal violation and possible isotensor current contributions in pion photoproduction and radiative capture are pointed out. (auth)

6164 CORRELATIONS IN PROTONS. Papini, G. (Univ. of Saskatchewan, Regina). Lett. Nuovo Cim.; 5: No. 6, 478-82 (7 Oct 1972).

It is shown how previous results can be obtained in which proton charge can be identified with quantized magnetic flux in the experimental region well described by form factors of a given type, and that if magnetic flux and charge coincide then charge and magnetic form factors satisfy a given relation in the Breit frame of the proton. The frame of a model for a composite proton in which correlations are assumed from the very beginning is used. The model is extended to include the spin which then appears as the flux quantum of the inertial field gen-

erated by the system of particles that make up the proton. It is pointed out that in the present form the model contains features of a more ambitious theory of elementary particles. (J.F.P.)

6165 ENERGY DEPENDENCE OF INCLUSIVE PION SPECTRA IN PION-INDUCED REACTIONS AND THE THERMODYNAMIC MODEL. Than, Htun; Ranft, J. (Karl-Marx Univ., Leipzig). Lett. Nuovo Cim.; 5: No. 9, 655-61(28 Oct 1972).

The inclusive pion spectra in π^+p and π^-p interactions are calculated using essentially the strong thermodynamic bootstrap method, and are compared with experimental data at 3.7 to 18.5 GeV/c. It is found the most essential features of the inclusive pion spectra are well reproduced by the model. (L.B.S.)

6166 INTERPOLATION FORMULA FOR SINGLE-PARTICLE SPECTRA. Kinoshita, K.; Noda, H. (Kyushu Univ., Fukuoka). Lett. Nuovo Cim.; 5: No. 9, 683-8(28 Oct 1972).

An interpolation formula based on urbaryon rearrangement diagrams is used to describe the gross features of the longitudinal shapes of spectra for the inclusive reactions $K^+p \to cX$ ($c = K^0$, K^{*+}, Λ, and $\bar{\Lambda}$) and $K^-p \to \Lambda X$ around 10 GeV/c. (L.B.S.)

6167 ELASTIC p–p SCATTERING AROUND $t = -0.8(GeV/c)^2$ AND THE DUAL ABSORPTIVE MODEL. Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 5: No. 11, 761-5(11 Nov 1972).

It is examined whether the anomalous behavior of the vector–meson exchange amplitude and the double zero in the polarization observed in elastic pp scattering near $t = -0.8(GeV/c)^2$ are consistent with the dual absorptive model. It is shown that good fits can be obtained when interference effects between the amplitudes due to the ρ and ω trajectories are taken into account. (L.B.S.)

6168 SELF-SIMILARITY AND MULTI-FIREBALL THEORY OF MULTIPLE PROCESSES. Akimov, V. N.; Volkov, E. I.; Dremin, I. M.; (and others) (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1673-6(Aug 1972). (In Russian).

The amplitude of purely elastic scattering is discussed which possesses vacuum quantum numbers in a crossed channel. A number of observations are made in connection with the basic properties of inelastic processes and their cross sections, especially regarding: the asymptotic constancy of total cross sections, the absolute value of asymptotic cross sections of pp and πp-interactions, pre-asymptotic behavior of cross sections, the energy dependence of cross sections in the accelerating region of energies wherein lie the cross sections, construction of the diffraction cone, the dependence of the function $\varphi(t)$ (a residue in relativistic representation) on varying t at small values of $|t|$, and the dependence of the amplitude on the virtual state of the colliding particles k^2. (K.S.W.)

6169 MODEL SIMULATION OF INELASTIC INTERACTION OF PARTICLES AT HIGH AND ULTRA-HIGH ENERGIES. Barashenkov, V. S.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1682-6(Aug 1972). (In Russian).

Experimental data on the properties of inelastic interactions of particles were analyzed. Analytical approximations and energy characteristics of secondary particles were obtained in a center of mass system. After allowing for the conservation of energy–momentum, these approximations were used in the establishment of the characteristics of inelastic πN- and NN interactions with the aid of the Monte-Carlo method. (tr-auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 6071.

6170 (ITF–72–120–E) ELASTIC p–d SCATTERING AT SMALL ANGLES AND HIGH ENERGIES. Enkovskii, L. L.; Il'in, V. V.; Tutik, R. S.; Shafranova, M. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 7p. Dep. NTIS (U. S. Sales Only).

Elastic pd-scattering at small angles and high energies is described in the framework of the Glauber model with the deuteron form factor parametrized in the form of two exponents. (auth)

6171 (ITF–72–121–E) MODEL FOR POMERON TRAJECTORY. Enkovskii, L. L.; Il'in, V. V.; Koen-Tannudzhi, Zh.; Tutik, R. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 12p. Dep. NTIS (U. S. Sales Only).

A parametrization of the vacuum trajectory with correct threshold and asymptotic behavior is suggested. The model perfectly fits existing experimental data on elastic pp-scattering. (auth)

6172 (LBL–981) DECK MODEL FOR TRIPLE-REGGE COUPLINGS. Sorensen, Cristian (California Univ., Berkeley. Lawrence Berkeley Lab.). 25 Aug 1972. Contract W-7405-eng-48. 58p. Dep. NTIS.

Thesis.

Inclusive cross sections in the triple-Regge region are calculated using a version of the ABFST multiperipheral model that amounts to an extension of the Deck model. Even though almost no parameters are available for adjustment, presently available moderate-energy data are described in a qualitatively satisfactory manner. Predictions are made for future experiments at higher energies, and the various triple-Regge couplings are extracted from the model. It is found that vertices corresponding to high-lying trajectories are suppressed. In particular the dimensionless parameter η_{ppp} that characterizes the triple-pomeron vertex turns out to be $\lesssim 10^{-3}$. (auth)

6173 (SLAC–Trans–144) SLOPE PARAMETER OF ELASTIC p–p SCATTERING DIFFERENTIAL CROSS SECTION. Chernev, Kh. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). Translated for Stanford Linear Accelerator Center, Calif., from report JINR–P1–6358. 13p. Dep. NTIS.

The slope-parameter values for the differential cross sections for elastic p + p interactions are determined for momentum transfers from 0.015 to $0.16(GeV/c)^2$ in the same region for which this parameter was determined from previous colliding beam experiments but at lower energies. (J.F.P.)

6174 LOW-ENERGY ΣN SCATTERING PARAMETERS: K-MATRIX ANALYSIS. Alexander, G.; Gell, Y.; Stumer, I. (Tel Aviv Univ., Israel). Phys. Rev., D; 6: No. 9, 2405-10(1 Nov 1972).

The recently reported new $\Sigma^\pm$ p cross-section data have been used to evaluate the low-energy scattering parameters in terms of the reaction K-matrix formalism. In the analysis the Coulomb contributions to the scattering processes were explicitly incorporated into the formalism. Out of the three sets of values obtained in a fit of the six scattering parameters, two are consistent with the observed rise in the forward Σ^+p differential elastic scattering. (auth)

6175 MULTIPLICITY DISTRIBUTION AT 200 GeV AND THE INVERSE-SQUARE FALLOFF. Hwa, R. C. (Univ. of Oregon, Eugene). Phys. Lett.; 42B: No. 1, 79-82(13 Nov 1972).

The deviation of the multiplicity distribution at 200 GeV from the n^{-2} behavior is explained by a consideration of the exponential damping in momentum transfer for double diffractive excitation processes. From a fit to $\sigma(n_c)$ at 200 GeV, the energy dependences of $\sigma(n_c)$, $\langle n_c \rangle$ and $\langle n_c(n_c - 1) \rangle$ are predicted. The agreement with data is good. (auth)

6176 ENERGY DEPENDENCE OF $\langle n(n-1) \rangle$ AND $\langle n \rangle/D$ IN HIGH-ENERGY p–p COLLISIONS FROM 13 TO 10^4 GeV/c. Ganguli, S. N.; Malhotra, P. K. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett.; 42B: No. 1, 88-90(13 Nov 1972).

The energy dependence of $\langle n(n-1) \rangle$ and $\langle n \rangle/D$ for charged particles, in the broad range 12.9 to 10^4 GeV/c, is compared with the predictions of fragmentation models and the multiperipheral models. It is concluded that the data favors the multiperipheral models. (auth)

6177 COHERENT PRODUCTION OF Ω^- AND Ξ HYPERONS ON NUCLEI AND DETERMINATION OF THEIR SPIN AND PARITY. Kopeliovich, B. Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern.Fiz.; 16: No. 3, 583-93(Sep.1972). (In Russian).

The reactions of coherent dissociation of mesons on nuclei into hyperon — antihyperon pairs at high energy were treated. It is shown that in such processes one can measure $\Omega^- - \Xi$-hyperon spin and parity. The results are presented in the form applicable for direct analysis of experimental data. (auth)

6178 $pN \to NNK\bar{K}$ REACTIONS IN MODELS WITH SINGLE-KAON EXCHANGE. Kopeliovich, V. B. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 16: No. 3, 579-82(Sep 1972). (In Russian).

The total cross sections for $pp \to ppK^0\bar{K}^0$ and $pp \to pnK^+\bar{K}^0$ reactions, calculated in the model with single-kaon exchange, do not contradict available experimental data in the proton momentum range $p_{lab} = 4.95$ to 8.00 GeV/c. A set of ratios between cross sections for productions of $\bar{K}$ on protons and neutrons were obtained in the framework of the model. The production cross section of K^- on a neutron is shown to be approximately twice as high as that on a proton. (auth)

6179 TWO-TERM NONLOCAL SEPARABLE POTENTIALS IN THE THREE-NUCLEON PROBLEM. Lamot, G. H.; El Baz, E.; Fayard, C.; Pigeon, J. (Univ., Lyon). Lett. Nuovo Cim.; 5: No. 9, 647-54(28 Oct 1972).

Various types of two-term nonlocal separable potentials are

tested in the determination of the triton binding energy and in the evaluation of the differential and total cross sections for n-d elastic scattering at 14.3, 25.7, and 28 MeV. It is found that the use of two-term nonlocal separable interactions gives a slight improvement for the triton binding energy, but it does not modify very much the n-d elastic cross sections. (L.B.S.)

6180 SEMIEMPIRICAL MODEL OF INCLUSIVE NUCLEON AND PION PRODUCTION FROM PROTON–NUCLEUS COLLISIONS. O'Brien, Keran (Atomic Energy Commission, New York). Trans. Amer. Nucl. Soc.; 15: No. 2, 966-7(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6181 MONTE CARLO SIMULATION OF HADRONIC CASCADES WITH NEW PARTICLE YIELD FORMULAS. Ranft, J. (Karl Marx Univ., Leipzig). Trans. Amer. Nucl. Soc.; 15: No. 2, 967(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6182 PRODUCTION AND PROPAGATION OF ATMOSPHERIC NEUTRONS. Wilson, J. W. (Langley Research Center, Hampton, Va.). Trans. Amer. Nucl. Soc.; 15: No. 2, 969-70(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6183 MULTIPLE IMPACTS AND AN OPTICAL MODEL OF INELASTIC INTERACTIONS OF COSMIC PARTICLES WITH NUCLEI. Balashov, V. V.; Kanevskii, B. L.; Korenman, G. Ya. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 8, 1677-81(Aug 1972). (In Russian).

The agreement of two models is discussed: the model of repeated Glauber scattering, and the optical model which describes inelastic cross sections of interaction of high energy particles with nuclei. Conditions are stated under which the Glauber model transforms into the optical model. Total cross sections are calculated for the production of new particles during collisions of nucleons with the nuclei ^{12}C, ^{57}Fe, and ^{208}Pb as a function of the parameters of the nucleon–nucleon amplitude. In the case of carbon, results derived from the optical model differ noticeably from those of the more accurate computations. (tr-auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 6201.

6184 (ITF-72--100-P) APPROXIMATE LORENTZ-INVARIANCE IN THE CLASSICAL MECHANICS OF THE PARTICLE SYSTEM. II. Gaida, R. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 39p. (In Russian). Dep. NTIS (U. S. Sales Only).

The conception of approximate Lorentz-invariance developed previously is applied to the study of transformation properties of nonrelativistic and quasi-relativistic Hamiltonians of interacting particle classical systems. The Lorentz invariants definition of the connection between simultaneities of spatially divided events in various inertial reference frames allows one to set up analytic relations between nonlocal magnitudes of two particle system Hamiltonian type expressed in two reference frames is proposed. The differential equation which is the necessary condition of approximate Lorentz-invariance of quasi-relativistic Hamiltonian of two interacting particle systems is formulated. (auth)

6185 (JINR–P2-6689) ON THE COMPLETE SET OF OBSERVABLES ON THE SPHERE IN THE THREE-DIMENSIONAL COMPLEX SPACE. Lukach, I.; Totkh, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

The most general complete set of commuting operators on the sphere in three-dimensional complex space is demonstrated. It is shown that this set of diagonal operators is realized for the most general parametrization of the sphere in this space. The wave eigenfunctions of this set of operators are constructed. These functions are the elliptical basis for irreducible SU(3) group representations. (auth)

6186 CONFORMALLY COVARIANT DESCRIPTION OF THE SCALING LAW. Yang, Y. C. (National Tsing Hua Univ., Hsinchu, Taiwan). Chin. J. Phys. (Taiwan); 10: No. 1, 29-34(Apr 1972).

In order to describe the scaling law in a general conformal way, a new variable is introduced. With this conformal variable the scaling is found to hold also for small values of q^2. The bound state N* is shown to have an accidental symmetry. (auth)

6187 MAXIMUM PERIODIC SUBGROUPS OF THE SU(3) GROUP. Nguyen Kuok Thi (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 15-22 (1972). (In Russian).

The theorem is demonstrated that there are in essence six coupled subgroups of the special unitary group SU(3). (K.S.W.)

6188 NOTE ON THE PARAMETERS AND THE VOLUME ELEMENT OF SU(n). Datta Majumdar, S. (Indian Inst. of Tech., Kharagpur, India). J. Phys., A (London); 5: No. 11, 1573-7(Nov 1972).

A convenient parametrization for SU(n) which exhibits the chain of subgroups, $SU(n-1) \supset SU(n-2) \ldots \supset SU(1)$, is proposed and the invariant volume element is calculated. (auth)

Applications (Electromagnetic and Weak)

6189 CPT CONSTRAINTS ON $K_{S,L} \rightarrow \mu\bar{\mu}$ DECAYS. Mathur, V. S. (Univ. of Rochester, N. Y.). Phys. Lett.; 42B: No. 1, 108-10(13 Nov 1972).

Discussion of the constraints on $K_{S,L} \rightarrow \mu\bar{\mu}$ decays following from CPT invariance alone. The results have interesting bearing on the problem of unitarity saturation, in particular reference to possible anomalously large intermediate state contributions from known or hitherto unknown particles. (auth)

6190 ABOUT DISCRETE SYMMETRIES IN ELECTRODYNAMICS. Strazhev, V. I.; Nguyen Vin Kuang (Inst. of Physics, Minsk). Yadern. Fiz.; 16: No. 3, 614-19(Sep 1972). (In Russian).

It is shown that the traditional character of transformation of electromagnetic field under space inversion and time reversal is a particular case of the most common transformations. It is based on the possibility of formulating electrodynamics with one type of charge in dual symmetrical form. (auth)

Applications (Strong)

Refer also to abstract 6149.

6191 EVIDENCE FOR A HIGH SYMMETRY. Yang, Y. C. (National Tsing Hua Univ., Hsinchu, Taiwan). Chin. J. Phys. (Taiwan); 10: No. 2, 93-7(Oct 1972).

SU(4) is proposed as a possible candidate for a higher symmetry. Special emphasis is placed on the classification of the multiplets for including (η',δ) degeneracy, $(\omega,\tilde{\omega})$ degeneracy, Z_0^* exotic resonances and splitting A_2. (auth)

Field Theories

General

Refer also to abstract 6190.

6192 NEWMAN–PENROSE CONSERVED QUANTITIES IN BORN–INFELD ELECTRODYNAMICS. Chellone, D. S. (Univ. of Newcastle upon Tyne, Eng.). J. Phys., A (London); 5: No. 11, 1545-9(Nov 1972).

The Newman–Penrose conserved quantities for the Born–Infeld nonlinear electromagnetic theory and the Einstein–Born–Infeld theory are shown to be precisely the same as those for the Maxwell and Einstein–Maxwell theories respectively. It is suggested that this occurrence is due to the particular nature of the nonlinearity of the Born–Infeld field equations. (auth)

6193 QUANTIZATION OF THE BORN–INFELD THEORY. Olsen, S. O. Lett. Nuovo Cim.; 5: No. 11, 745-7(11 Nov 1972).

It was suggested by Dirac that a quantized Born–Infeld electrodynamics could possibly be obtained by introducing anticommuting quantities in the very description of the field. It is shown that such a redefinition of the field concept implies that the Born–Infeld theory is inherently quantized, i.e., no additional application of commutators is then required to quantize the theory. (L.B.S.)

Quantum Field Theory

6194 (ITF-72-75-E) UNITARY DRESSING TRANSFORMATION OF THE HAMILTONIAN FOR ϕ^4 QUANTUM FIELD THEORY. Zolotaryuk, A. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 19p. Dep. NTIS (U. S. Sales Only).

A unitary dressing transformation is constructed for the ϕ^4

theory as a formal series of well defined operators. This construction permits one to perform a limiting transition to an infinite volume. The convergence of an expansion of μ^{-1} Hμ (H is the Hamiltonian of the ϕ^4 model) is proved. (auth)

6195 (ITF-72-110-P) PROOF OF THE S-MATRIX UNITARITY IN NONLOCAL QUANTUM FIELD THEORY. Alebastrov, V. A.; Efimov, G. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 49p. (In Russian). Dep. NTIS (U. S. Sales Only).

In a quantum theory of the one-component scalar field $\varphi(x)$ nonlocality for a wide class of interaction Lagrangians is introduced by means of form factors which are the entire analytical functions in the momentum space. Such a regularization procedure is introduced which has the following properties: The regularization S°-matrix is defined and there exists the limit: $\lim_{\delta\to 0} S^{\delta} = S$. The Green's functions Δ^{ϵ}, which define an operation of product in $S \cdot S^{+} = S \circledast S^{+}$, are also regularized $\circledast^{\delta}$ and there exists the limit $\lim_{\delta\to 0} \circledast^{\delta} = \circledast \equiv$. The operator $J(\delta_1, \delta_2, \delta_3) = S^{\delta_1} \circledast {}^{\delta_2}S^{\delta_3+}$ is continuous at the point $\delta_1 = \delta_2 = \delta_3 = 0$. $S^{\delta} \circledast S^{\delta+} \equiv 1$ for $\delta > 0$. Consequently, the S-matrix is unitary, i.e., $S \circledast S^{+} = S \cdot S^{+} = 1$. (auth)

6196 (ORO-3992-77) ANALYTICITY IN QUANTUM FIELD THEORY. II. CAUSALITY AND DISPERSION RELATIONS. Rechenberg, H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany). Texas Univ., Austin. Center for Particle Theory); Sudarshan, E. C. G. (Texas Univ., Austin. Center for Particle Theory). Aug 1972. Contract AT(40-1)-3992. 45p. (CPT-131). Dep. NTIS.

The consequences from causality in high energy physics are studied, with particular reference to the well known claim that a strong connection exists between causality and global analyticity of the scattering amplitudes. It is demonstrated that this relation is not as tight as has been conventionally taken for granted, but depends on additional assumptions imposed on the scattering amplitudes in the unphysical as well as in the physical region; at present no experimental tests of these extra assumptions can be given. Therefore one tries to discard them and explore a new concept of causality, which assures the usual (covariant) cause-event structure only over macroscopic distances and allows for violations in microscopic regions. Quantum field theory with "shadow states" is examined and found to be consistent with this macroscopic causality, though not necessarily leading to the so-called normal analytic scattering amplitudes. (auth)

6197 (ORO-3992-101) FINITE QUANTUM AND CLASSICAL ELECTRODYNAMICS. Sudarshan, E. C. G. (Texas Univ., Austin. Center for Particle Theory). Jul 1972. 21p. (CPT-155; CONF-720646-3). Dep. NTIS.

From third Rochester conference on coherence and quantum optics; Rochester, N. Y. (21 Jun 1972).

A continuing investigation of relativistic finite quantum electrodynamics which is free from mathematical absurdities, in agreement with physical results, and conceptually satisfactory is reported. (J.F.P.)

6198 POMERON COUPLINGS. Moen, I. O.; White, A. R. (Cambridge Univ., Eng.). Phys. Lett.; 42B: No. 1, 75-8(13 Nov 1972).

It is shown that recent derivations of the vanishing of the inclusive Pomeron–Reggeon-particle vertex at zero Pomeron mass do not require the vanishing of that part of the full vertex containing the Reggeon poles. Therefore the Pomeron is not required to decouple in total cross-sections. (auth)

6199 PHENOMENOLOGICAL MODEL OF THE FITZGERALD–LORENTZ CONTRACTION BASED ON INTERACTIONS WITH THE NEUTRINO SEA. Dudley, H. C. (Univ. of Illinois, Chicago). Lett. Nuovo Cim.; 5: No. 9, 641-4(28 Oct 1972).

Linear contraction as a function of velocity is developed as a first order approximation within classical mechanics by extending the hypothesis of the existence of a generalized isotropic flux of uncharged particles (e^0) having rest mass of the electron. A model is examined wherein there occurs inelastic scattering of uncharged electrons (e^0) by orbital electrons. (L.B.S.)

6200 FASTER-THAN-LIGHT INERTIAL FRAMES, INTERACTING TACHYONS, AND TADPOLES. Goldoni, R. (Univ., Pisa, Italy). Lett. Nuovo Cim.; 5: No. 6, 495-502(7 Oct 1972).

A review is given of some results of research on tachyons. The possibility is investigated of describing particles that travel faster than light within the special theory of relativity, introducing mathematically faster-than-light inertial frames and extending the principle of relativity to all inertial frames slow and fast. A field theory for spinless noninteracting tachyons is developed, and a formal development is given for the interactions between bradyon and tachyon fields. (J.F.P.)

6201 SYMMETRY AND RENORMALIZABILITY OF THE THEORIES OF MASSIVE VECTOR FIELDS. Vainshtein, A. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). Lett. Nuovo Cim.; 5: No. 9, 680-2(28 Oct 1972).

In the Lagrangian description of the define helicity fields it is shown that any Lagrangian of an isotriplet of massive vector fields has SU(2) × SU(2) symmetry. If there are no additional particles, the zero helicity fields realize the nonlinear representation of the symmetry group and their Lagrangian is nonpolynomial and nonrenormalizable. The possibility of constructing the linear representation of the group and therefore the renormalizable theory, with the addition of scalar fields, is pointed out. (L.B.S.)

6202 PERTURBATION THEORY FOR ODD PERTURBATIONS. Byers Brown, W. (Univ. of Manchester, Eng.). J. Phys., A (London); 5: No. 11, 1563-5(Nov 1972).

The eigenvalues of a perturbed Schroedinger equation with an odd perturbation are even functions of the perturbation parameter λ. It is shown how to transform the perturbed equation so that the new perturbation is also explicitly an even function of λ. (auth)

6203 HIGH-ENERGY SCALAR ELECTRODYNAMICS AND THE FUNCTIONAL INTEGRATION METHOD. Bui-Duy, Q. (Univ. of Montreal); Nguyen, T. D. Lett. Nuovo Cim.; 5: No. 11, 774-6(11 Nov 1972).

The functional integration method is used to study the short-distance behavior of scalar electrodynamics. It is found that the scalar electron propagator is identical to a propagator of a free and massless particle. (L.B.S.)

6204 PHOTON PROPAGATOR IN A CLASS OF GAUGES IN QUANTUM ELECTRODYNAMICS. Urrutia, F. (Univ. of Chile, Santigo). Lett. Nuovo Cim.; 5: No. 11, 788-92(11 Nov 1972).

It is shown that it is possible to construct the photon propagator in a class of gauges in quantum electrodynamics by using the standard methods of canonical quantization. The usual Lagrangian density for quantum electrodynamics is modified in the Lorentz gauge adding to it terms containing new fields coupled to the Dirac current. (L.B.S.)

Gravitation and General Relativity

6205 MASS OF THE GRAVITON. Van Dam, H.; Veltman, M. (Univ. of North Carolina, Chapel Hill). Gen. Relativity Gravitation: 3: No. 3, 215-20(Oct 1972).

The relation between the mass of the π-meson and the range of the Yukawa force is well known. The same relation has been often used to find a small upper value for the mass of the graviton. It is shown that for a spin-2 particle, such as the graviton, the relation between the mass of the particle and the interaction which it mediates is richer than for a spin-0 particle. It is concluded, on the basis of experiment, that the mass of the graviton must be zero, and not just small. (auth)

6206 SLOW-MOTION APPROXIMATIONS IN GENERAL RELATIVITY. I. DECOMPOSITION OF THE FIELD EQUATIONS. Dixon, W. G. (Cambridge Univ., Eng.). Gen. Relativity Gravitation: 3: No. 3, 227-49(Oct 1972).

A new (3 + 1)-dimensional decomposition of the Einstein gravitational field equations is obtained for a general spacetime. The metric is taken in the form $ds^2 = e^{-2u}\kappa_{ab}(d\xi^a + \xi^a dt)(d\xi^b + \xi^b dt) - c^2e^{2u}dt^2$, and the resulting equations treat κ_{ab} as the metric in the space-like hypersurfaces t = constant. It is shown that this decomposition forms a more convenient starting point for slow motion approximations than does their usual 4-dimensional formulation. This is illustrated by a derivation of the first post-Newtonian approximation to the field equations, the simplicity there resulting from κ_{ab} being still flat to this order. (auth)

6207 EXTERNAL SOURCES IN GENERAL RELATIVITY. Stachel, J. (King's Coll., London). Gen. Relativity Gravitation: 3: No. 3, 257-67(Oct 1972).

The use of the metric $g_{\mu\nu}$ and the tensor density $\mathfrak{T}_{\mu\nu}$ as a suitable combination of variables to use for formulation of an external source problem in general relativity and how any other pair may be chosen is discussed. For any choice of metric variables, covariant, contravariant and densities of any weight it is necessary merely to pick the source term as a tensor of appropriate indices and weight to make the contracted product a scalar density. It is also clear that if a scalar-tensor type of gravitational theory is formulated similar results will hold, so long as the interaction term in the Lagrangian for the external source is a scalar density. (UK)

6208 COVARIANT EXPRESSION OF ENERGY–MOMENTUM IN THE RELATIVISTIC THEORY OF GRAVITATION.

Chevalier, Jean (Univ., Geneva); Stueckelberg de Breidenbach, E. C. G. Helv. Phys. Acta; 45: 587-92(1972).

The relativistic linear formalism developed by W. Scherrer leads to a covariant expression of gravitational energy-momentum. In the case of a mass distribution with spherical symmetry (Schwarzschild's exterior solution), this tensor gives a total gravitational energy equal to $-Mc^2$. How can the minus sign be interpreted? A detailed analysis of Schwarzschild's interior solution shows that the gravitational energy has to be considered as a generalization of the classical potential energy, which is negative in the attractive case. (auth)

6209 NEW KERR-LIKE SPACE-TIME. Demianski, M. (Univ., Warsaw). Phys. Lett.; 42A: No. 2, 157-9(20 Nov 1972).

A new solution of the Einstein field equations depending on four arbitrary constants was obtained by the method of complex coordinate transformations. It is of type II and possesses a wire-like singularity. (auth)

6210 APPLICATIONS OF FORMAC IN THE MATHEMATICS OF GENERAL RELATIVITY. Wahlquist, H. D. JPL Quart. Tech. Rev.: 1: No. 1, 13-16(Apr 1971).

The use of FORMAC (formula manipulation by computer) to perform symbolic analysis on the computer in the field of general relativity is described. FORMAC will accept symbolic analytical expressions involving complex algebraic functions, elementary transcendental functions, user-defined functions, and unspecified functions of any number of dependent variables. In particular, FORMAC programs have not been written to implement the non-commutative calculus of exterior differential forms. Applications of this new capability to Hamiltonian cosmology and the theory of partial differential equations are discussed. (auth)

6211 DECOMPOSITION IDENTITY FOR A CLASS OF RIEMANNIAN INVARIANTS. Pavelle, R. (Univ. of Arizona, Tucson). Proc. Cambridge Phil. Soc.; 72: No. 3, 459-63(Nov 1972).

An identity of fundamental interest in general relativity is the breakup or "decomposition" of the scalar curvature density into an ordinary divergence in addition to a term constructed solely from the metric tensor and its first derivative. It is proven that this identity is the most elementary example of an identity satisfied by all members of a particularly important class of Riemannian invariants. For a subset of these invariants, the decomposition identity undergoes a simplification that connects this material with some problems of current research interest. (auth)

Scattering Theory

Refer also to abstracts 6148, 6195, 6196, 6588, and 6589.

6212 (ITF-72-98-E) REGGE BEHAVED DUAL AMPLITUDES SATISFYING THE MANDELSTAM REPRESENTATION. Bugrii, A. T.; Enkovskii, L. L.; Kobylinskii, N. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 10p. Dep. NTIS (U. S. Sales Only).

The properties of dual amplitudes with Mandelstam analyticity (DAMA) and trajectories which increase slower than a linear function are studied. A class of trajectories is found which ensures Regge asymptotic behavior of DAMA in the whole S-plane; the amplitude with such trajectories satisfies the Mandelstam representation. (auth)

6213 (ITF-72-102-P) ASYMPTOTIC BEHAVIOR OF AMPLITUDES AND CROSS SECTIONS. Elinek, Yu. E.; Lomsadze, Yu. M. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 46p. (In Russian). Dep. NTIS (U. S. Sales Only).

A brief analysis of the problem of the axiomatic basis of the high energy relations and a survey of the available formulation of the Pomeranchuk theorem and others connected with this theorem high-energy restrictions on the scattering amplitude, and cross sections of processes are given. Particular attention is paid to the oscillation problem. An integral relation stating a correlation between asymptotics of difference of total cross sections and the self cross sections under the assumption that the latter are "smooth" functions and do not vanish at infinity is given. (auth)

6214 (ITF-72-108-E) LARGE ANGLE SCATTERING IN DAMA. Bugrii, A. I.; Enkovskii, L. L.; Kobylinskii, N. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 15p. Dep. NTIS (U. S. Sales Only).

The behavior of a dual amplitude with Mandelstam analyticity (DAMA) at high energies and fixed nonzero scattering angles is studied. It is shown that besides the Regge behavior at fixed momenta transfers the amplitude also exhibits correct dependence on S and t at fixed scattering angles, which fits experiment and agrees with rigorous bounds of the S-matrix theory. (auth)

6215 (JINR-P4-6708) OFF-ENERGY-SHELL t-MATRIX IN THE BOUNDARY CONDITION MODEL. Efimov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is shown that in the boundary condition model the off-energy shell t-matrix can be obtained on the basis of the boundary conditions, imposed on the off-energy-shell wave function, and under the assumption that the model t-matrix has the same analytical properties as t-matrix has, which satisfies the Lippmann–Schwinger equation. (auth)

6216 SCATTERING SYSTEMS WITH FINITE TOTAL CROSS SECTION. Jauch, J. M.; Sinha, K. (Univ., Geneva). Helv. Phys. Acta; 45: 580-6(1972).

A sufficient condition for the finiteness of the total cross section in a simple scattering system is given. Various corollaries of the main theorem are also discussed. (auth)

6217 PERTURBATION OF THE COULOMB POTENTIAL BY A CONTACT INTERACTION. Edwards, D. Jr. (Univ. of Kentucky, Lexington). Phys. Lett.; 42A: No. 2, 111-12(20 Nov 1972).

It is shown that the addition of a constant interaction of the form $(1/a^3)\delta(r-a)$ does not shift the ground state energy level for the Coulomb potential in the limit as a approaches zero. (auth)

6218 BOUNDS FOR THE SCATTERING AMPLITUDE AT HIGH ENERGIES. Novikov, V. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 3, 603-7 (Sep 1972). (In Russian).

Bounds for the scattering amplitude, averaged in angle, were obtained. The estimation of t-channel singularities in backward scattering is presented. (auth)

6219 MODELS FOR HADRONIC AND LEPTONIC PROCESSES AT HIGH ENERGY. Landshoff, P. V.; Polkinghorne, J. C. (Cambridge Univ., Eng.). Phys. Rep.; 5C: No. 1, 1-55(Oct 1972).

A review is given of the theory of Regge cuts, the structure of reggeon coupling functions; and the field-theory approach to the parton model of deep inelastic leptonic processes. Each of the three parts is self-contained, but similar momentum-space techniques are used throughout. (auth)

PHYSICS (LOW-TEMPERATURE)

6220 PROCEEDINGS OF THE TWELFTH INTERNATIONAL CONFERENCE ON LOW TEMPERATURE PHYSICS. Conference Held in Kyoto, Japan, September 4–10, 1970. Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971). 897p. (CONF-700921).

After the London Award lecture by P. W. Anderson and an invited paper by D. Pines entitled "Inside Neutron Stars", this collection of 369 contributed papers divides into sections as follows: (A) Helium, 78 papers, (B) Superconductivity, 145 papers, (C) Metals and Semimetals, 49 papers, (D) Magnetism, 74 papers, and (E) Other Low-Temperature Phenomena and Devices, 23 papers. A separate abstract was prepared for each of 167 papers. Two papers have previously appeared in NSA; see NSA 25: 3205 and 3990. (L.M.T.)

For abstracts of individual papers see: 5858, 6042, 6224–6271, 6285–6393, 6835–6841, and 6871.

Superfluidity

Refer also to abstract 5858.

6221 PHONON SPECTRUM OF SUPERFLUID HELIUM. Havlin, S.; Luban, M. (Bar-Ilan Univ., Ramat-Gan, Israel). Phys. Lett.; 42A: No. 2, 133-4(20 Nov 1972).

The phonon excitation spectrum of superfluid ^{4}He is calculated self-consistently, employing a renormalized hydrodynamic Hamiltonian. The theoretical results for the sound velocity are in excellent agreement with experiment. The phonon spectrum agrees with the Woods–Cowley neutron measurements. (auth)

6222 SEARCH FOR BOSE–EINSTEIN CONDENSATION IN SUPERFLUID ^{4}He. Mook, H. A.; Scherm, R.; Wilkinson, M. K. (Oak Ridge National Lab., Tenn.). Phys. Rev., A.; 6: No. 6, 2268-71(Dec 1972).

A search was made for Bose–Einstein condensation in superfluid ^{4}He, using neutron inelastic scattering. A two-component scattering distribution was resolved for ^{4}He at 1.2°K giving direct evidence for the existence of the zero-momentum state. Analysis of the measured data leads to a condensate fraction of $(2.4 \pm 1)\%$, a value much smaller than previously estimated. (auth)

6223 SURFACE SEPARATION IN DILUTE LIQUID MIXTURES OF ^{4}He IN ^{3}He. Laheurte, J. P. (Centre de Recherches sur les Tres Basses Temperatures, Grenoble, France). Phys. Rev., A.; 6: No. 6, 2452-6(Dec 1972).

A model is proposed to explain the superfluid-film formation in dilute liquid mixtures of ^{4}He in ^{3}He. It is shown that the difference of mass between the isotopes increases the ^{4}He adsorption near the walls. Previous and new measurements are in good agreement with the model. (auth)

6224 EXPERIMENTAL TESTS OF SCALING LAWS NEAR THE SUPERFLUID TRANSITION IN ^{4}He UNDER PRESSURE. Aghlers, G. (Bell Telephone Labs., Inc., Murray Hill, N. J.). pp 21-7 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Measurements of the heat capacity, the pressure coefficient $(\partial P/\partial T)_v$, and the thermal conductivity of liquid helium near the superfluid transition under pressure are presented and analyzed in terms of scaling-law predictions. Several deviations from theory are revealed by the data. Neither the heat capacity at constant pressure nor the thermal conductivity fully reflect the symmetry of the transition which is implied by scaling. (auth)

6225 THIRD SOUND, FOURTH SOUND, AND THE HEALING LENGTH OF SUPERFLUID HELIUM. Rudnick, I. (Univ. of California, Los Angeles). pp 29-32 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The results of experiments using third sound and fourth sound to measure size effects are presented. Third-sound measurements, in particular, determine the temperature-dependent healing length. They also yield the results that, at onset, the superfluid fraction is finite and equal to 0.37, and that the liquid film thickness is 4.5 times the healing length. (auth)

6226 PROPERTIES OF LIQUID HELIUM FROM INELASTIC NEUTRON SCATTERING. Woods, A. D. B.; Cowley, R. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 33-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The inelastic scattering of thermal neutrons by liquid helium was studied over a wide range of energy ($\hbar\omega$) and momentum ($\hbar Q$) transfers. At 1.1°K the scattering consists of a sharp one-phonon peak and a broad diffuse background peak. The energy and momentum transfers corresponding to the one-phonon peak directly yield the Landau excitation curve. The mean energy of the broad peak as a function of Q gives rise to a curve for which $\hbar\omega/k_B = 18 \pm 2$°K as $Q \to 0$, and at large momentum ($Q > 3$Å^{-1}) is similar to that expected from a system of free particles. The scattering is consistent with that predicted by known sum rules. (auth)

6227 SOUND ATTENUATION MEASUREMENTS IN THE MICRODEGREE NEIGHBORHOOD OF THE LAMBDA POINT OF HELIUM. Williams, R. D.; Rudnick, I. (Univ. of California, Los Angeles). pp 47-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The attenuation of first sound was measured near the lambda point of liquid helium. It is asymmetric about T_λ, with a maximum on the low temperature side. The attenuation can be interpreted as being due to two phenomena: (1) a relaxation process occurring only below T_λ; and (2) a critical attenuation that is nonsingular and symmetrical about T_λ. (auth)

6228 OPTICAL MEASUREMENTS ON HIGH-FREQUENCY SECOND SOUND CLOSE TO THE LAMBDA POINT. Cunsolo, S.; Grillo, G.; Jacucci, G. (Univ., Rome). pp 49-50 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The velocity of a generated second sound wave was measured by Brillouin scattering near the lambda point. (auth)

6229 CRITICAL HEAT CURRENTS IN LIQUID HELIUM II NEAR T_λ. Bhagat, S. M.; Lasken, R. A. (Univ. of Maryland, College Park). pp 51-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The heat current, Q, which causes a sharp drop in the high conductivity of He II was measured for T near T_λ. The transition temperature, T_B, varies linearly with Q. An explanation based on phenomenological theories, modified to include vortex lines, is suggested. The spatial variation of temperature in the fluid for $T \leq T_B$ is also discussed. (auth)

6230 HEAT FLOW IN SUPERFLUID HELIUM NEAR THE LAMBDA TRANSITION. Crooks, M. J.; Johnson, D. L. (Univ. of British Columbia, Vancouver). pp 53-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Heat flows and temperature differences were measured on samples of He II of cross section about 1 mm^2 to within 25 μK of T_λ. The results are fitted to a generalized Gorter–Mellink mutual friction expression of the form $\dot{q} = \rho_s ST(S \text{ grad } T/a\rho_n)^{1/m} (T_\lambda - T)^{-\alpha/m}$. (auth)

6231 NUCLEAR RELAXATION IN THE CRITICAL REGION OF ^{3}He/^{4}He LIQUID MIXTURES. Saito, S.; Terui, G.; Kanda, E. (Tohoku Univ., Sendai). pp 55-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The longitudinal and transverse relaxation times, T_1 and T_2, were measured between 0.35°K and 3.0°K in pure liquid ^{3}He and in ^{3}He–^{4}He liquid mixtures of ^{3}He concentrations of 0.428 and

0.645. Relative linewidths and wiggles in a fixed resonance condition, related to T_2, exhibit anomalies near the λ points. (auth)

6232 SPECIFIC HEAT OF LIQUID ^{3}He/^{4}He MIXTURES NEAR THE JUNCTION OF THE LAMBDA AND PHASE-SEPARATION CURVES. Alvesalo, T. A.; Berglund, P. M.; Islander, S. T.; Pickett, G. R.; Zimmermann, W. Jr. (Tech. Univ. of Helsinki, Otaniemi, Finland). pp 57-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The specific heat of liquid ^{3}He/^{4}He mixtures was measured at saturated vapor pressure for eight values of the ^{3}He mole fraction x in the range $0.53 \leq x \leq 0.73$ from ~0.6 to ~1.4 K. The results are presented in the form of the specific heat $c_{P,x}$ at constant pressure and mole fraction for the liquid. Both the lambda peak and the discontinuity in $c_{P,x}$ as the system goes from the two-liquid-phase region into the one-liquid-phase region tend to disappear as the junction of phase boundaries is approached. (auth)

6233 DISSIPATIVE EQUATION FOR SUPERFLUID HELIUM: AN EXPERIMENTAL DETERMINATION. Chester, M.; Williams, D. R.; Motloch, C. (Univ. of California, Los Angeles). pp 61-3 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Recent work has suggested, contrary to the traditional view, that superfluid flowing helium does not have a critical speed above which dissipation sets in; rather, a driving force is necessary to induce flow at all speeds. However, at sufficiently small speeds, the force is exponentially and hence inaccessibly small experimentally. Experiments to test the proposed formula describing this phenomenon are reported on. With some small modifications, reasonable agreement is found between the experiments and the more current view. (auth)

6234 EXPERIMENTAL STUDY OF THE INTERDEPENDENCE OF NORMAL AND SUPERFLUID FLOW IN HELIUM II. van der Heijden, G.; van der Boog, A. G. M.; Kramers, H. C. (Kamerlingh Onnes Lab., Leiden). pp 65-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Combinations of flows of normal and superfluid He, with different velocities, were studied by measuring chemical potential temperature, and pressure differences over a capillary. An extra pressure difference was found when the superfluid flow was turbulent. The chemical potential difference shows a cubic dependence on a modified relative velocity for most of the combinations of (v_n, v_s). (auth)

6235 FOURTH-SOUND ATTENUATION AND QUANTUM EFFECTS DUE TO A SUPERFLOW IN A POROUS MEDIUM. Francois, M.; LeRay, M.; L'Huillier, D.; Bataille, J. (Faculte des Sciences, Orsay, France). pp 67-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The dissipation associated with superflows in porous media was studied. When the frequency is high enough, or in the vicinity of the λ point, the data can be considered as evidence in favor of the existence of quantum-interference effects. (auth)

6236 MEASUREMENTS OF PERSISTENT CURRENTS IN HELIUM BY DOPPLER-SHIFTED FOURTH SOUND: A NEW EFFECT. Rudnick, I.; Kojima, H.; Veith, W.; Kagiwada, R. S. (Univ. of California, Los Angeles). pp 69-71 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Using the Doppler-shifted splitting of the fourth sound modes of an annular resonator, measurements were made on persistent currents. Rotation of the resonator when there is an existing persistent current produces unexpected results that are interpreted in terms of differing thresholds for introducing vortex lines of opposite sign. (auth)

6237 INFLUENCE OF HEAT FLOW THROUGH A VORTEX PINNING MEDIUM ON THE DENSITY OF HELIUM II. Dorscheidt, A. G. F.; Frederking, T. H. K.; van Kempen, H.; Wyder, P. (Katholieke Univ., Nijmegen, Netherlands). pp 73-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The effect on the density of He II of a high energy density heat flow (~5 watt/cm^2) through a channel, 0.02 cm wide, filled with a vortex pinning medium was studied. It is concluded, that the major portion of the density increase during heat flow can be explained by the assumption of local thermodynamic equilibrium. (auth)

6238 EFFECT OF A SUPERFLOW AND A COUNTERFLOW ON A VORTEX LATTICE. Le Ray, M.; Bataille, J.; Francois, M.; L'Huillier, D. (Faculte des Sciences, Orsay, France). pp 75-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Second-sound attenuation singularities observed in simultaneous heat flow or superflow and rotation experiments provide evidence that the vortex lattice created by rotation is triangular. (auth)

6239 VORTEX MOTION IN He II. Campbell, L. J. (Los Alamos Scientific Lab., N. Mex.). pp 77-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The two-dimensional, hydrodynamic motion of superfluid vortices is calculated for various geometries and initial vortex configurations. The effect of friction due to relative motion of the vortices and normal fluid is included. The cases discussed include vortices in channels and rotating buckets and the two-dimensional analog of vortex rings near a plane boundary and at an orifice. (auth)

6240 QUANTIZED ROTATION OF SUPERFLUID HELIUM. Guernsey, R. W. Jr. (Stanford Univ., Calif.). pp 79-81 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

An experiment to observe the quantized flow of superfluid helium in a torus is underway. A transverse partition containing a small hole provides the mechanism by which circulation jumps are induced at certain angular velocities. The torus is fastened to the bob of a high-Q torsion pendulum which modulates the steady rotation provided by a rotating table and the earth. When a circulation jump occurs, there should be a measurable decrease in the Q as a result of energy loss associated with superflow breakdown in the hole. Preliminary data are presented. (auth)

6241 JOSEPHSON–ANDERSON EFFECTS IN SUPERFLUID HELIUM. Hulin, J. P.; Perrin, B.; Laroche, C.; Libchaber, A. (Ecole Normale Superieure, Paris). pp 83-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Two types of experiments on separated superfluid helium baths weakly coupled by a small hole (15 to 20 μ diameter) are described here. In the first place, a superfluid flow was created between the two baths with no chemical potential difference (dc Josephson effect). In the second place, the Anderson–Richards experiments (ac Josephson effect) were developed. (auth)

6242 DETERMINATION OF hN USING JOSEPHSON EFFECTS IN SUPERFLUID HELIUM. Khorana, B. M. (Univ. of Rochester, N. Y.). pp 85-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Progress towards an accurate measurement of ac Josephson effect in superfluid helium and the significance of this measurement in the determination of fundamental constants is described. (auth)

6243 DETERMINATION OF ROTON LINEWIDTHS BY RAMAN SCATTERING. Greytak, T. J.; Yan, J. (Massachusetts Inst. of Tech., Cambridge). pp 89-90 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The temperature dependence of the spectrum of light Raman scattered by liquid helium was used to measure roton linewidths in the temperature region where they are determined by roton–roton scattering. It is found that above 1.3°K the full width at half height, δE, of the energy corresponding to a single roton is given by $\delta E/k = (84 \pm 11)\, T^{\frac{1}{2}} \exp - E_0/kT$ in °K, where E_0 is the mean energy of a roton. (auth)

6244 PROPAGATION OF SOUND IN LIQUID ^{4}He BELOW 0.6°K. Klein, R.; Wehner, R. K. (RCA Labs., Zurich). pp 91-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The self-energy for long-wavelength phonons interacting with thermal phonons is calculated for a model system with anharmonic interactions corresponding to liquid ^{4}He. Taking vertex corrections into account improves the agreement with experiments on sound absorption and velocity. The effect of dispersion is also discussed. (auth)

6245 GENERATION OF HIGH-DENSITY CHARGE CARRIERS IN LIQUID He II. Date, M.; Hori, H.; Kamata, H. (Osaka Univ.). pp 93-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Two new methods of generating charge carriers in liquid He II were developed. One of them is called the spark discharge method which can produce both + and – currents up to 1 μA. Using this method, generation of various kinds of ions in He II becomes possible. Another new source of charge carriers in photo-emitted electrons of about 0.01 μA from a Na film. (auth)

6246 INJECTION OF CHARGE INTO LIQUID HELIUM BY FIELD EMISSION AND FIELD IONIZATION. Hickson, A.; McClintock, P. V. E. (Univ. of Lancaster, Eng.). pp 95-7 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Measurements are reported of field-emission/ionization currents from sharp tungsten points held between ± 5 kV into liquid helium in the range 0.3 to 4.2 K; and direct observation of a glowing microsopic bubble of vapor enveloping the emitting tip was made. The complex temperature dependence of the current is discussed in terms of a space charge trapped on vorticity. (auth)

6247 MOBILITY OF NEGATIVE IONS IN He I AND He II MEASURED WITH A NEW METHOD. Blaisse, B. S.; Goldschvartz, j. M.; Naeye, M. (Univ. of Tech., Delft, Netherlands). pp 99-100 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

When ions move in a liquid they exert a force on this liquid. By measuring this force and the current, one can calculate the mobility. The current emitted by a tungsten tip in liquid helium is space-charge-limited. The mobility is found to be independent of the field between 7 and 27 kV/cm. (auth)

6248 THERMAL CONDUCTION IN He II BELOW 0.8K – NEAR A FIELD-EMISSION CURRENT SOURCE. McClintock, P. V. E. (Univ. of Lancaster, Eng.). pp 101-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A drastic reduction in effective thermal conductivity of a column of He II was observed when a field-emission current source, immersed in the liquid, is switched on. This result can be interpreted in terms of vorticity generated near the emitter and appears to shed light upon the complex current–temperature characteristics of field emission in He II. (auth)

6249 ION TRANSMISSION THROUGH THE ^{3}He–^{4}He PHASE BOUNDARY. Kuchnir, M.; Roach, P. R.; Ketterson, J. B. (Argonne National Lab., Ill.). pp 103-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The electron current crossing the liquid ^{3}He–^{4}He phase boundary was studied experimentally. The interpretation of these and other data yields values for a boundary width parameter, ξ, for both the ^{3}He–^{4}He and the ^{4}He liquid–gas phase boundaries. (auth)

6250 LOW-TEMPERATURE ION MOBILITY IN ^{3}He–^{4}He SOLUTIONS. Ketterson, J. B.; Kuchnir, M.; Roach, P. R. (Argonne National Lab., Ill.). pp 105-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The negative and positive ion mobilities were studied in a number of ^{3}He–^{4}He solutions. For dilute solutions the negative ion mobility starts from an asymptotic $T^{-\frac{1}{2}}$ behavior at low temperatures. This is followed by a mobility maximum near 0.28 K, after which the mobility decreases rapidly due to roton scattering. The positive ion mobility is found to be approximately temperature-independent. (auth)

6251 EVIDENCE FOR A SUPERFLUID-INDUCED SURFACE BARRIER FOR ELECTRONS IN LIQUID HELIUM. Schoepe, W.; Probst, C. (Technische Univ., Munich). pp 107-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The free surface of liquid helium acts as an energy barrier on electron currents across the surface into the vapor, if the liquid is superfluid. The barrier depends on the extracting electric field in agreement with an image-potential model. Using a simple ansatz for the extracted currents, the zero-field barrier is shown to be linearly temperature-dependent between 1.4 K and 1.8 K, vanishing at T_λ. (auth)

6252 STRUCTURE OF TURBULENT SUPERFLUID HELIUM. Sitton, D.; Moss, F. (Univ. of Virginia, Charlottesville). pp 109-10 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Negative ions are used to probe the structure of a bulk sample of He II exposed to a supercritical heat current. Capture and escape processes, in agreement with the theory of Donnelly, show that the sample is penetrated by an irregular array of quantized vortex lines. New measurements on the escape probability up to 1.8°K are presented. (auth)

6253 MEASUREMENTS OF EQUILIBRIUM AND FLOWING HELIUM FILMS. Matheson, C. C.; Blair, D. G. (Univ. of East Anglia, Norwich, Eng.). pp 111-12 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The change in period produced by a helium film on a conical surface undergoing low-frequency torsional oscillations was measured. Using this technique, the film-thickness profile and the temperature dependence of film thickness were examined. The drainage of bulk fluid from the conical surface, and the radiation dependence of evaporation from the film were also observed. (auth)

6254 ENERGY GAP FOR HELIUM-FILM EXCITATIONS. Brown, J. B.; Tong, M. G. (Kent Univ., Canterbury, Eng.). pp 113-14 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The mass of helium film covering quartz crystals was studied by measuring their resonant frequencies. At 10 MHz the superfluid film follows the motion of the plate vibrating in pure transverse shear motion even when the surface velocity is less than the usual critical flow velocity. The phenomenon appears to be analogous to excitation across the energy gap of a superconductor. (auth)

6255 ACCURATE CALCULATION OF THIRD SOUND AND AN INVESTIGATION OF THE PROPERTIES OF SOUND WAVES INCIDENT ON A VAPOR–LIQUID HELIUM II BOUNDARY. Meinhold-Heerlein, L.; Loos, R. (Johannes-Gutenberg Univ., Mainz). pp 115-16 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

In order to calculate both the dispersion relation of third sound and the coefficients of reflection and transmission of sound waves incident on a vapor-helium II boundary, Khalatnikov's equations are solved with appropriate boundary conditions. The results of the calculations agree with investigations of Atkins and Pollack in the case of third sound, but seem to disagree with Chernikova's calculations of the properties of sound waves reflected and transformed at a vapor/helium II interface in the case of first-sound incidence. (auth)

6256 EXPERIMENTAL INVESTIGATION OF TRANSMISSION AND REFLECTION OF FIRST-SOUND WAVES INCIDENT ON A LIQUID HELIUM SURFACE. Brandt, D.; Keck, K. (Univ., Mainz). pp 117-18 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The transmission and reflection of first sound at a liquid He interface, and dependence on the angle of incidence, were investigated between 1.5 and 4.2 K. (auth)

6257 INSTABILITY AND ONSET IN SUPERFLUID FILMS. Goldstein, D. L. (California Inst. of Tech., Pasadena). pp 119-21 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Attention is called to two features of the onset of superfluidity in thin helium films: the rise in resistance to flow is surprisingly sharp at onset, and the film would become hydrodynamically unstable if superflow did not cease. A successful theory should be expected to account for the sharp change, and describe an ensuing state which is stable. (auth)

6258 OSCILLATIONS AND DISSIPATION IN THE FLOW OF THE SATURATED HELIUM FILM. Hammel, E. F.; Keller, W. E.; Sherman, R. H. (Los Alamos Scientific Lab., N. Mex.). pp 123-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Studies of liquid level oscillations resulting from He II film transfer indicate that, up to T = 2.133 K, the bulk liquid superfluid fraction $(\rho_s/\rho)_B$ is appropriate for the flowing saturated film but that the superfluid critical velocity $v_{s,c}$ vanishes at 2.144 K where $(\rho_s/\rho)_B = 0.165$. The superflow onset T is lower than expected, attesting to the indeterminate character of $v_{s,c}$ near T_λ. (auth)

6259 THICKNESS OF THE STATIC AND MOVING He II FILM. Keller, W. E. (Los Alamos Scientific Lab., N. Mex.). pp 125-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Capacitance measurements, which sample the thickness, d, of the flowing He II film in the dissipation region, indicate that to within ±5 Å, d is not altered by the presence of the dissipation processes. The relation between d and the transfer rate is discussed. (auth)

6260 FILM TRANSFER OF HELIUM II BELOW 1°K. Martin, D. J.; Mendelssohn, K. (Claredon Labs., Oxford). pp 127-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Details of the sudden changes of transfer rate are given. It is suggested that the increase in rate at low temperatures might be due to a high vortex density. There is no significant change of film thickness at low temperatures. (auth)

6261 HELIUM II FILM TRANSFER RATES FOR LARGE LEVEL DIFFERENCES. Radhakrishnan, T. S.; Rangarajan, S.; Chandra, G. (Tata Inst. of Fundamental Research, Bombay). pp 129-30 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Measurements of the helium II film flow rates in the temperature range 1.59 to 1.07°K over a glass substrate do not show any dependence on pressure heads up to the measured range of 29 cms. Nevertheless the constant flow rates obtained in different runs or at two different time periods in the same run show scatter beyond the experimental errors. (auth)

6262 STRUCTURE OF ADSORBED He II FILM. Amit, D. J. (Stanford Univ., Calif.). pp 131-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A He II film is treated in a theory similar in form to the Hartree approximation, but which differs in two essential features: (1) it includes the imprint of the zero-temperature excitation spectrum on the ground state, and (2) the fact that He II is a liquid is incorporated. Such a theory is known to describe quite well the surface tension of He II and the structure of vortices. It is shown that a stable solution exists for a film near a substrate with realistic attractive well. (auth)

6263 PRESSURE DEPENDENCE OF THE SOLUBILITY OF LIQUID ^{3}He IN SUPERFLUID ^{4}He. Abraham, B. M.; Brandt, O. G.; Eckstein, Y. (Argonne National Lab., Ill.). pp 161-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The limiting solubility of ^{3}He in superfluid ^{4}He was measured for a number of solutions at five pressures in addition to the vapor pressure. At absolute zero the solubility increases from $x_3 = 0.0660$ at P = 0 to $x_3 = 0.0967$ at P = 17 atm with no evidence for a maximum as found by Landau et al. and by Watson et al. (auth)

6264 SPECIFIC HEAT AT CONSTANT OSMOTIC PRESSURE OF ^{3}He IN SUPERFLUID ^{4}He. Radebaugh, R.; Siegwarth, J. D. (NBS Inst. for Basic Standards, Boulder, Colo.). pp 163-5 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The specific heat of ^{3}He in superfluid ^{4}He, $C\mu_4$, was measured for the case where μ_4, the ^{4}He chemical potential in solution, or the osmotic pressure are held constant. The measurements reported here cover the range 0.02 to 0.7 K and the ^{3}He concentration range of 5 to 22%, and were made by the continuous flow calorimetric technique in a dilution refrigerator. Comparison with theory is made. (auth)

6265 MEASUREMENT OF THE VISCOSITY OF ^{3}He–^{4}He SOLUTIONS. Lai, C. M.; Craig, P. P.; Kitchens, T. A.; Brewer, D. F. (Brookhaven National Lab., Upton, N. Y.). pp 167-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Some preliminary results of an investigation of the viscosity near the superfluid transition and the peak in the phase separation in ^{3}He–^{4}He solutions are presented. The experimental apparatus, a combination viscometer and dielectric constant measuring device, is described. (auth)

6266 VELOCITY OF SECOND SOUND IN LIQUID MIXTURES OF ^{3}He AND ^{4}He AT LOW TEMPERATURES. Sherlock, R. A.; Brubaker, N. R.; Edwards, D. O.; Sarwinski, R. E.; Seligmann, P. (Ohio State Univ., Columbus). pp 169-70 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The velocity of second sound was measured in liquid ^{3}He–^{4}He mixtures between 0.034 and 0.6°K for ^{3}He concentrations from 0.14% to 6.3% and pressures to 20 atm. By means of earlier measurements of the osmotic pressure and Khalatnikov's hydrodynamic equation for the velocity of second sound, the normal fluid density ρ_n and the inertial ^{3}He mass $m_i = \rho_n/n_3$ were determined. Assuming that the ^{3}He quasi-particle energy spectrum is $\epsilon_i = -E_3 + p^2/2m_0^* + \gamma p^4 + \Sigma_j V_{ij}$, the ^{3}He effective mass, m_0^* which is the same as the inertial mass at zero temperature, concentration and pressure, was found to be (2.28 ± 0.04) times the bare ^{3}He mass. (auth)

6267 KINETIC THEORY OF DILUTE SOLUTIONS OF ^{3}He IN ^{4}He. Disatnik, Y.; Yanover, A. (Tel-Aviv Univ., Israel). pp 171-3 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The kinetic theory of the dilute superfluid solution of ^{3}He in ^{4}He is formulated under the assumption that the system has only phonon and ^{3}He quasi-particle excitations. Expressions are obtained for various thermodynamic parameters, for the currents associated with the densities of the conserved variables, and for the transport coefficients. (auth)

6268 EFFECTIVE ^{3}He QUASI-PARTICLE INTERACTION IN SUPERFLUID ^{4}He. Eckstein, S. G.; Eckstein, Y.; Kuper, C. G.; Ron, A. (Technion-Israel Inst. of Tech., Haifa). pp 175-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The effective ^{3}He–^{3}He potential, V_0, is related thermodynamically to the excess molar volume. When the non-thermodynamic assumption of Bardeen et al., is not used, the result differs from theirs. The cancellation of leading terms in V_0 does not lie in the fact that ^{3}He is an isotopic impurity. (auth)

6269 MAGNETIC SUSCEPTIBILITY AND SPIN DIFFUSION COEFFICIENT OF ^{3}He-^{4}He SOLUTIONS UNDER PRESSURE. Cheng, D.; Craig, P. P.; Kitchens, T. A. (Brookhaven National Lab., Upton, N. Y.). pp 179-81 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The dilute ^{3}He–^{4}He solutions form a convenient system for comparison with the present state of Fermi liquid theory. Here preliminary results are reported of an investigation of these solutions from the saturated vapor pressure to the solidus line of the spin-diffusion coefficient and the magnetic susceptibility. A description of the experiment is also given. (auth)

6270 ENERGY SPECTRUM OF THE EXCITATIONS IN LIQUID HELIUM II. Sunakawa, S.; Yamasaki, S.; Kebukawa, T. (Osaka Univ.). pp 183-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The excitation spectrum in liquid helium II was studied from first principles. The higher-order excitation energy, in which the effect of the phonon–phonon interaction is taken into account, is calculated by making use of a new convergent method and by assuming the Morse potential with a soft repulsive core between helium atoms. The result is in good agreement with experiments. (auth)

6271 NEW THEORY OF LIQUID HELIUM II. Wong, K. W. (Univ. of Southern California, Los Angeles). pp 195-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

An exact two-body pseudopotential is developed to replace the hard core in the helium–helium interaction. A self-consistent-field method for the many-boson system is formulated, with off-diagonal long-range ordering included. It is found that, at liquid helium density and reasonable hard-core size, the amount of zero-momentum condensate in the ground state is negligible. An investigation of the instability or the Hartree–Fock ground state of such a system against the formation of opposite-momentum pairs was done, which showed in fact an instability occurs irrespective to the amount of residual Bose–Einstein condensate. The properties of superfluidity of this system are therefore ascribed to pair formation. Such a phase transition is of second order, and the critical temperature of a bulk system is obtained. The result agrees well with experiments. (auth)

6272 RAMAN SCATTERING AND TWO-ROTON BOUND STATES IN LIQUID HELIUM. Cowley, R. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Phys., C (London); 5: No. 21, L287-91(31 Oct 1972).

The Raman scattering from liquid helium was calculated by use of the measured dispersion relation for the excitations and a model for the coupling between the light and these excitations. A comparison of the results with experimental measurements suggests that the attractive interaction between the excitations is much weaker than presently supposed, and that the binding energy of a two-roton bound state, if it exists at all, is less than 0.1°K. (auth)

Superconductivity

6273 (AD–745011) ROLE OF SURFACE OXIDE IMPURITIES IN THE "KNEE" EFFECT IN SUPERCONDUCTING TUNNEL JUNCTIONS. Fremmer, H.; MacVicar, M. L. A.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science). 12 Jun 1972. Contract N00014-67-A-0204-0041. 23p. NTIS.

A qualitative model based on the effect of impurity states in the barrier is presented to explain the anomalous "knee" in the I–V characteristics of superconducting tunnel junctions. The temperature dependence predicted by the model was experimentally confirmed, and the appearance, disappearance, and the severity of the anomaly was controlled reproducibly by controlled junction fabrication. The junctions were made by evaporating thin films on to the oxidized surfaces of Nb single crystals which had been grown in ultrahigh vacua by the floating zone technique. It is reported that control of impurities in the barrier itself (rather than surface effects at the metal/oxide interface) according to the model can completely control the appearance of the anomaly. (auth) (GRA)

6274 (ANL–7903) PLASTICITY OF SINGLE CRYSTALS OF NIOBIUM, NIOBIUM–MOLYBDENUM, LEAD, AND LEAD ALLOYS IN THE SUPERCONDUCTING AND NORMAL STATES AT 4.2°K. Kostorz, G. W. (Argonne National Lab., Ill.). Jul 1972. Contract W-31-109-eng-38. 55p. Dep. NTIS.

The effects of the superconducting $\rightleftharpoons$ normal transition on the plastic properties of metals and alloys recently attained increased interest because of the hope that the electronic-drag contribution to the mobility of dislocations can be extracted from detailed experiments in the superconducting and normal states. The experimental observations during constant strain rate, creep, and stress-relaxation tests with superimposed transitions superconducting $\rightleftharpoons$ normal are reviewed. The current theoretical results for the electronic-drag coefficient in normal conductors and superconductors are discussed, and the difficulties in arriving at a complete and unique interpretation of all experimental results are described. Constant strain-rate experiments at 4.2°K with a large number of single crystals of niobium, niobium–molybdenum, lead, and lead–tin, lead–bismuth, lead–thallium, and lead–cadmium are described and discussed. The observed flow-stress difference $\Delta\tau_{SN}$ for the two states depends sensitively on work hardening, solute concentration, and solute properties, but no strain-rate sensitivity of $\Delta\tau_{SN}$ is found. This latter result implies that the transition superconducting $\rightleftharpoons$ normal causes a change in the strength of obstacles, either by the change of electronic-drag coefficient or by a change of dielectric screening. In the absence of a low-temperature rate theory for dislocation movement, the suggested interpretations remain unsatisfactory. (auth)

6275 POSSIBLE NEW ELECTRONIC PHASE IN SEMIMETALS. I. Lo., S. C. (Univ. of Kansas, Lawrence); Wong, K. W. Nuovo Cim.; 10B: No. 2, 361-82(11 Aug 1972).

The problem of the excitonic phase in semimetals is studied by including a strong electron–phonon interaction term. The pure excitonic phase is found to be unstable under this possible condition. The different situations in which the electron–phonon term is important are discussed. A new type of phase similar to the superconducting phase could be found. The different physical implications of such a phase are studied. A self-consistent field method is also developed such that electromagnetic responses can be studied. (auth)

6276 SOME ELECTROMAGNETIC RESPONSES IN THE PROPOSED MIXED PHASE. II. Lo, S. C. (Univ. of Kansas, Lawrence); Wong, K. W. Nuovo Cim.; 10B: No. 2, 383-406 (11 Aug 1972).

Following the authors' first paper on a possible new electronic phase in semimetals, some electromagnetic responses of such a "mixed" phase were investigated. It was concluded that, while a pure excitonic insulating phase might be difficult to obtain in experiments, a "mixed" phase basically superconducting in general character might be found in superconducting semimetals. Such a system has a Meissner effect quite different from that of a Type-I superconductor, in that the critical magnetic field decreases as the system goes through a superconducting and "mixed" phase transition. (auth)

6277 FREQUENCY PULLING IN JOSEPHSON JUNCTIONS. Ulrich, B. T. (Univ. of Texas, Austin). Phys. Lett.; 42A: No. 2, 119-21(20 Nov 1972).

The frequency of electromagnetic radiation emitted by a Josephson junction is pulled to a resonant frequency of a surrounding cavity. This effect occurs without modification of the Josephson voltage–frequency relationship. (auth)

6278 INFLUENCE OF THE PHONON SPECTRUM AND THE COULOMB INTERACTION ON THE JUMP IN THE SPECIFIC HEAT OF SUPERCONDUCTORS. Golub, A. A.; Kon, L. Z. (Inst. of Applied Physics, Kishinev, USSR). Phys. Lett.; 42A: No. 1, 11-12(6 Nov 1972).

The jump in the specific heat $(C_s/C_n)_{T=T_c}$ is evaluated by taking account of the Coulomb interaction as well as the interaction between electrons. For this purpose the integral equations for the energy gap function $\Delta(\omega)$ and for the renormalization parameter $Z(\omega)$ are used. (auth)

6279 ONE-DIMENSIONAL PERIODIC SUPERCONDUCTING WEAK-LINK SYSTEMS. Blackburn, J. A. (Univ. of Western Ontario, London); Schwartz, B. B.; Baratoff, A. Phys. Lett.; 42A: No. 1, 31-2(6 Nov 1972).

The one-dimensional Ginzburg–Landau equation is solved for the case of a linear, periodic weak-link system. For currents below a critical value, four solutions for the spatially dependent order parameter are obtained. (auth)

6280 HEAT CAPACITY OF DISORDERED AND CRYSTALLINE SUPERCONDUCTORS. Viswanathan, R.; Kammerdiner, L. (Univ. of California, San Diego, La Jolla). Phys. Lett.; 42A: No. 1, 25-6(6 Nov 1972).

Low-temperature heat-capacity measurements on disordered and crystalline $Nb_{0.26}Zr_{0.74}$ alloys show that the former has a much larger heat capacity jump ($\Delta C/\gamma T_c \approx 2.4$) than the latter and that the disorder decreases the superconducting transition temperature (T_c) rather than enhances it. (auth)

6281 FILAMENTARY COMPOSITE WIRES WITH SUPERCONDUCTING LAYERS OF V_3Ga. Wilhelm, M. (Siemens AG, Erlangen, Ger.); Springer, E. Z. Naturforsch.; 27a: No. 10, 1462-7(Oct 1972). (In German).

Superconducting layers of V_3Ga are formed at the interface of solid-state V/(Cu, Ga) diffusion couples during heat treatment. Growth of diffusion layers was investigated as functions of temperature, time, and composition of the copper–gallium alloy. Deformability and recrystallization behavior of (Cu, Ga) and electrical properties of filamentary V_3Ga composite wires are reported. (auth)

6282 NMR IN SUPERCONDUCTORS. Weger, M. (Hebrew Univ., Jerusalem). Pure Appl. Chem.; 32: No. 1-4, 325-38(1972).

Various microscopic features of superconductivity, and NMR experiments relating to them, are discussed. Some of the properties of superconductors are: (1) The pairing of electrons with opposite spins, which is the basic feature of the BCS theory, and which manifests itself in a reduction of the Knight shift. (2) The creation of a gap, which causes the number of excitations at low temperatures to be proportional to $\exp(-2\Delta/kT)$, and the relaxation rate to be proportional to this quantity. (3) The coherent nature of the superconducting state, which causes $1/T_1$ just below T_c to exceed $1/T_1$ in the normal state. (4) The property of gapless superconductivity, observed in some systems (mainly with magnetic impurities, or in a magnetic field), which affects $1/T_1$. (5) In a magnetic field, some ('type II') superconductors possess an array of magnetic flux lines. Some information about the geometry of this array can be obtained from the NMR linewidth and lineshape. (6) Inside the flux lines, superconductivity is effectively destroyed and consequently the relaxation rate there, is characteristic of the normal metal. (7) The magnetic flux lines are not rigid. Therefore, they fluctuate thermally yielding an additional relaxation mechanism. (8) Very near T_c, the gap parameter Δ is not constant (in time and space), but fluctuates thermally. This yields an additional relaxation mechanism, which should be relatively strong in superconductors with a quasi one-dimensional band structure. This effect has apparently been observed. (auth)

6283 CPA CORRECTIONS TO THE TRANSITION TEMPERATURE OF SUPERCONDUCTORS CONTAINING MAGNETIC IMPURITIES. Zuckermann, M. J. (McGill Univ., Montreal). Solid State Commun.; 11: No. 9, 1169-71(1 Nov 1972).

The transition temperature T_c of superconducting alloys containing magnetic impurities is calculated in the coherent potential approximation (CPA). The CPA correction to the expression for T_c in the self-consistent t-matrix approximation is calculated in the limit of low magnetic impurity concentrations n and is shown to be quadratic in n. The relation to the Kondo effect is discussed. (auth)

6284 DIRECT OBSERVATION OF MAGNETIC MICROSTRUCTURE IN DEFORMABLE NIOBIUM-BASE SUPERCONDUCTING ALLOYS. Lazarev, B. G.; Ovcharenko, O. N.; Martynov, I. S. (Physical-Technical Inst., Kharkov). Dokl. Akad. Nauk SSSR; 205: No. 6, 1343-5(21 Aug 1972). (In Russian).
74538

The presence of n elementary currents in a superconductor in a magnetic field may be directly observed by depositing dispersed ferromagnetic particles at points of outflow of the magnetic field on the surface of the superconducting material. Such direct observation of the fine magnetic structure in the alloys Nb–60 at.% Ti and Nb–(30 to 37) at.% Ti–(25 to 28) at.% Zr was made using wires 0.25 mm in diameter at 4.2°K, and in magnetic fields of 6,750 and 22,200 Oe. Particles of Fe from 20 to 50 Å in size were distributed on the alloy surfaces in order to generate a pattern for observation with an electron microscope. (K.S.W.)

6285 LONDON AWARD LECTURE: BRIAN JOSEPHSON AND MACROSCOPIC QUANTUM INTERFERENCE. Anderson, P. W. (Bell Telephone Labs., Inc., Murray Hill, N. J.). pp 1-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The history of the Josephson effect discovery is traced, and its applications are discussed. (L.M.T.)

6286 SUPERCONDUCTING PROPERTIES OF SOME HOMOGENEOUS AND INHOMOGENEOUS SMALL SYSTEMS. pp 207-10 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Recent experimental work on small superconducting systems is reviewed. The study of proximity effect is used to investigate the interaction of normal Kondo systems with superconductors. The results are compared with other experiments and with theory on homogeneous systems. The possibility of the study of the electron–electron interaction in normal films (Cu, Ag) from the study of the magnetic behavior of N/S sandwiches is discussed. A study of the irreversible behavior of colloids of Type-I alloys (InBi) and of compounds (Hg_2Cd) is reported. (auth)

6287 FLUCTUATIONS AND RESISTANCE IN SUPERCONDUCTORS: THEORY. Hohenberg, P. C. (Bell Telephone Labs., Inc., Murray Hill, N. J.). pp 211-16 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The present theoretical understanding of the effect of fluctuations on the resistive transition in superconductors exists on two distinct levels, a phenomenological and a microscopic one. The first level is the time-dependent Ginzburg–Landau theory, which yields a consistent picture of the resistive transition in wires, films, and bulk materials. For the case of wires, detailed calculations have been carried out both above and below the mean-field transition temperature, and in the presence of a finite current. In the latter case, an instability is predicted for sufficiently large currents near the mean-field transition temperature T_c (J). On the microscopic level, attempts have been made to derive the phenomenological theory in terms of the starting Hamiltonian. In the limit of the large pair-breaking effect ($\tau_c \gg 1$) the phenomenological theory has indeed been shown to be correct, and the theory has the form proposed by Aslamazov and Larkin. For small pair-breaking ($\tau_c \ll 1$), on the other hand, the situation appears to be much more complicated, due to the presence of the so-called Maki terms. According to the analysis of Thompson, there exists a regime where the contribution of the Maki terms is significant, and where it may be calculated reliably from a single diagram. (auth)

6288 THERMODYNAMIC FLUCTUATIONS IN SUPERCONDUCTORS: EXPERIMENTAL SITUATION. Parks, R. D. (Univ. of Rochester, N. Y.). pp 217-23 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Thermodynamic fluctuations and critical point effects in superconductors, thought until recently to be unobservable, now comprise the subject of extensive theoretical and experimental activity.

The bulk of the experimental work to date has centered on the electric conductivity of small specimens in the transition region. It appears that results obtained on highly amorphous or granular systems, both above and below T_c, and on clean systems below T_c can be explained adequately by models based on a simplified time-dependent formulation of the mean field theory, shown recently by Gor'kov and Eliashberg to be strictly valid only in the presence of pair breaking. However, in clean systems where the simple approach is expected to be inadequate, the precursive activity in the electric conductivity above T_c is found to be much larger than predicted. These results can be explained semiquantitatively by Thompson's treatment of the so-called Maki diagrams. A review is given of this work together with a discussion of precursive diamagnetism and the manifestation of thermodynamic fluctuations in pair tunneling, electromagnetic absorption, and electron tunneling. (auth)

6289 ELECTROMAGNETIC RESPONSE OF TYPE-II SUPERCONDUCTORS IN THE VORTEX STATE. Maki, K. (Faculte des Sciences, Orsay, France). pp 225-9 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Recent theories are reviewed of the electromagnetic response in dirty type-II superconductors in the vortex state as well as in the surface superconducting sheath in a titled magnetic field. In these situations the vortex state exhibits resistive behavior due to motion of the vortex lattice structure under the microwave field. Simple calculations based on the time-dependent Ginzburg–Landau equations (TDGL) in various physical situations are presented. The relation between the general linear response theory and the TDGL calculation will be also discussed briefly. (auth)

6290 FLUX FLOW AND TRANSPORT PROPERTIES OF SUPERCONDUCTORS. Kim, Y. B. (Univ. of Southern California, Los Angeles). pp 231-7 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Transport properties of superconductors—electric conductivity, the Hall effect, and various thermomagnetic effects—are generally accounted for in terms of the mechanism of flux flow. A nonequilibrium situation created by electromagnetic or thermal perturbations causes the Abrikosov vortex lines to move across the superconductor, and the associated dissipation as well as the flow of entropy give rise to various transport effects. While qualitative or semiquantitative aspects of the experimental observations related to the flux flow phenomena can be fully accounted for by a model in which the dissipation and the entropy flow are attributed to the vortex core, the recent investigation of the time-dependent Ginzburg–Landau equation from the microscopic theory affords quantitative comparison of experiment and theory at least in the region where the superconducting gap parameter is sufficiently small. Presently available experimental data (both dc and microwave) on flux flow resistivity are compared quantitatively with the microscopic calculations of Caroli–Maki, and with the revised calculation by Thompson. (auth)

6291 SUPERCONDUCTIVITY AND THE ANDERSON MODEL. Takano, F.; Inoue, C. (Tokyo Univ. of Education). pp 239-40 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The change of the superconducting transition temperature is investigated in the Anderson model perturbationally. Taking the limit of $U \to \infty$, the Green functions of s-electrons are expanded up to the sixth order of the mixing interaction. In the magnetic case, the leading anomalous terms coincide with those of the exchange model, and, in the nonmagnetic case, anomalous terms do not appear at all. (auth)

6292 CRYSTAL FIELD EFFECTS ON SUPERCONDUCTIVITY. Fulde, P.; Keller, J. (Univ., Frankfurt am Main). pp 241-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The effect of magnetic impurities with crystal-field split energy levels in a superconducting matrix were studied as a function of impurity concentration n_i. It is found that the transition temperature T_c as function of n_i differs generally greatly from the predictions of the Abrikosov–Gorkov theory which does not take Stark splitting into account. This way it is possible to explain recent experiments on $La_{1-x}Pr_xPb_3$ by Bucher et al. (auth)

6293 SUPERCONDUCTIVITY AND KONDO EFFECT IN DILUTE Zn–Mn ALLOYS. Wassermann, E. F.; Falke, H.; Jablonski, H. P. (RWTH, Aachen). pp 243-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The T_c depression and the impurity resistance $\Delta\rho/c$—after destroying superconductivity with a weak field (100 G)—were investigated on dilute Zn–Mn alloys (0 to 24 ppM) between 0.3 and 20°K. $\Delta\rho/c$ does not reach the unitary limit down to 0.32°K, indicating a low $T_c < 0.5$°K). Remarkable changes in Kondo slope $-(1/C)(\partial\rho/\partial \ln T)$, resistivity ratio $\Delta\rho$ (4.2), and T_c appear during isochronal annealing, possibly indicating the influence of changes in the Mn distribution on the physical properties of the alloys. (auth)

6294 NMR STUDIES ON MAGNETIC-FIELD AND MAGNETIC-IMPURITY-INDUCED GAPLESS SUPERCONDUCTIVITIES IN $La_{3-x}Gd_xAl$ SYSTEM. Masuda, Y.; Hashimoto, M. (Nagoya Univ., Japan). pp 245-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The nuclear spin-lattice relaxation time T_1 of ^{27}Al in type-II superconductor $La_{3-x}Gd_xAl$ was measured as a function of concentration of Gd, x, as well as temperature and magnetic field. Anomalous relaxation behavior in superconducting state was observed. The field dependence is contrary to the case of spin diffusion to the vortex core, suggesting that the relaxation mechanism is due to the magnetic impurities. (auth)

6295 SPECIFIC HEAT AND MAGNETIZATION OF SUPERCONDUCTORS WITH MAGNETIC IMPURITIES. Aoi, T.; Mamiya, T.; Iwahashi, K.; Masuda, Y. (Nagoya Univ., Japan). pp 247-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Specific heat, magnetization, and mutual inductance were measured on a series $La_{3-x}Gd_xAl$ containing up to 1.0 at. % gadolinium. No significant departure from Abrikosov–Gor'kov theory was observed in the range of impurity concentration studied. Some spin correlation was observed above a magnetic transition temperature. Upper critical fields decreased monotonously with increasing gadolinium impurity concentration. (auth)

6296 MICROSCOPIC INVESTIGATION OF THE EFFECT OF MAGNETIC FIELDS ON FLUCTUATION SUPERCONDUCTIVITY. Tsuzuki, T.; Koyanagi, M. (Kyushu Univ., Fukuoka). pp 249-50 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Diamagnetic susceptibility and magnetoconductivity due to the fluctuation superconductivity are studied microscopically in the Ginzburg–Landau–Gorkov approximation. Those are calculated in infinite power-series of magnetic field. The results agree with those obtained from the semiphenomenological Ginzburg–Landau equation, when the latter are expanded in power-series of magnetic field. (auth)

6297 FLUCTUATIONS OF THE ORDER PARAMETER IN ZERO-DIMENSIONAL SUPERCONDUCTORS. Hurault, J. P.; Maki, K.; Beal-Monod, M. T. (Faculte de Sciences, Orsay, France). pp 251 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The effect of time-dependent fluctuations was studied in superconducting samples of which size is smaller than the coherence length. These effects are much more important than in the one-, two-, or three-dimensional superconductors. The divergent behavior of the static properties (specific heat, spin susceptibility) and of the dynamical properties (nuclear relaxation time) was investigated. (auth)

6298 FLUCTUATIONS IN SUPERCONDUCTORS BELOW T_c. Schmidt, H. (Technische Univ., Munich). pp 253-4 of Proceedings of the Twelfth International Conference on Low Temperature

Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The fluctuations of the order parameter in superconductors below T_c are described within the phenomenological Ginzburg–Landau theory. The penetration depth and the dynamical conductivity is calculated. It is shown that these fluctuations strengthen the superconductivity, i.e., the penetration depth is reduced and the dynamical conductivity is enhanced compared to the values without taking fluctuations into account. (auth)

6299 SURFACE EFFECTS IN THE ONSET OF SUPERCONDUCTIVITY. Mikeska, H. J. (Institut v. Laue-Langevin, Garching, Ger.). pp 255-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The onset of the Meissner effect is investigated in the presence of a surface. For magnetic fields above the surface nucleation field, H_{c3}, the fluctuation magnetization is independent of the boundary condition at the surface and agrees with the expression found without taking boundary conditions into account. Below H_{c3}, the presence of the surface sheath is reflected in an additional contribution to the fluctuation magnetization. (auth)

6300 CRITICAL BEHAVIOR IN THE LINEAR RESPONSE OF A SUPERCONDUCTOR TO A STATIC MAGNETIC FIELD. de Pasquale, F.; Tabet, E. (Instituto di Fisica, Rome). pp 257-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The order-parameter fluctuations are studied in the framework of the microscopic theory of superconductivity, both for $T > T_c$ and for $T < T_c$. Continuity of the critical local superfluid density $\rho_s(k)$ across T_c is shown. Long-range correlations arising from gauge-symmetry breakdown in the order parameter–order parameter correlation function $T(q)$ are found below T_c. Agreement with phenomenological theory and with some previous results for $T > T_c$ is found. (auth)

6301 FLUCTUATIONS NEAR THE ONSET OF THE RESISTIVE TRANSITION IN FILAMENTARY SUPERCONDUCTORS. Lukens, J. E.; Warburton, R. J.; Webb, W. W. (Cornell Univ., Ithaca, N. Y.). pp 261-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Measurements of the onset of the resistive transition and the current–voltage characteristics of one-dimensional single crystal tin whiskers, extended to a sensitivity of 10^{-15} volts, revealed the predicted thermally activated quantum phase slips of magnitude 2π and verified a theory for the rate of phase slippage based on the Ginsburg–Landau equations. (auth)

6302 RESISTIVE TRANSITION OF SUPERCONDUCTING GALLIUM FILMS. Aoki, R.; Kawaguchi, T.; Hatada, K.; Kawamura, N. (Kyushu Univ., Fukuoka). pp 263-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

In the temperature region below the superconducting transition point, the Curie–Weiss law is found, in terms of resistance R and temperature T, to be $R/(R_N - R) = \tau_{0III} \cdot T/(T_{cIII} - T)$. For samples with various thickness, the coefficient τ_{0III} corresponds to the τ_{0I} which is used in Aslamazov and Larkin's expression above the transition point. (auth)

6303 RESISTIVE TRANSITION IN CLEAN ONE-DIMENSIONAL SUPERCONDUCTORS. Thomas, G. A.; Parks, R. D. (Univ. of Rochester, N. Y.). pp 265-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The excess conductivity above T_{co} in relatively clean one-dimensional Al films is appreciably larger than that specified by the Aslamazov–Larkin approximation, but is adequately described by the model of Thompson. Preliminary data on similar samples suggests evidence for the critical point behavior predicted by Kawasaki and Tsuzuki. (auth)

6304 SUPERCONDUCTING FLUCTUATION EFFECTS ON THE S/I/N JUNCTION CURRENT. Takayama, H. (Tokyo Univ.). pp 267-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Compared with an ordinary S/I/N junction, an S/I/F junction, where the N metal of a S/I/N junction is just above its transition temperature, shows different behavior. Their origins are interpreted by the modification of the electronic density of states of the N metal due to the superconducting fluctuations and by the tunneling of Cooper pairs, existing temporarily even in the N metal. (auth)

6305 EXCESS CONDUCTIVITY OF A TUNNELING JUNCTION DUE TO FLUCTUATIONS. Yoshihiro, K.; Kajimura, K. (Electrotechnical Lab., Tokyo). pp 269-70 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Excess conductivity of a tunneling junction at zero voltage due to instantaneous Josephson currents caused by fluctuation pairing of electrons was found in $Pb/Al_2O_3/Al$ junctions. The excess conductivity observed is proportional to the square of the conductivity of the junction, where both metals are normal, as has been predicted by Ferrell, but the temperature dependence seems to remain unexplained. (auth)

6306 FLUCTUATION EFFECTS IN THE DIAMAGNETISM OF BULK SUPERCONDUCTORS. Gollub, J. P.; Beasley, M. R.; Tinkham, M. (Harvard Univ., Cambridge, Mass.). pp 271-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The dependence on temperature and magnetic field of the fluctuation-induced diamagnetism of superconductors above T_c appears to follow a universal behavior in terms of scaled variables if one introduces a new characteristic field, H_s, related to other known material-dependent parameters. (auth)

6307 APPARENT SUPERCONDUCTING ENERGY GAPS IN PURE NIOBIUM AND TANTALUM. Levy, M.; Carsey, F.; Kagiwada, R. (Univ. of California, Los Angeles). pp 273-5 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Two apparent superconducting energy gaps are obtained in pure niobium and tantalum from ultrasonic-attenuation measurements. A low value is calculated from low-temperature data. Data close to T_c yield a higher value. K. Maki has resolved this discrepancy. His theory that the apparent larger energy gap is produced by an electron mean free path shorter in the superconducting state than in the normal state is confirmed. (auth)

6308 MEASUREMENT OF SUPERCONDUCTING ENERGY GAPS WITH MICROWAVE ULTRASONICS. Dobbs, E. R.; Hughes, E.; Lea, M. J.; Rayne, J. A.; Jones, C. K. (Univ. of Lancaster, Eng.). pp 277-9 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Preliminary measurements of ultrasonic attenuation at high frequencies ($h\nu \cong 2\Delta$) in oriented aluminum and iridium crystal disks near their superconducting transition temperatures are described and compared with calculations from the BCS theory. Simultaneous measurement of the ultrasonic and magnetic transitions show the discontinuity in attenuation below T_c that is expected at high frequencies. (auth)

6309 TWO-GAP SUPERCONDUCTING ALLOYS. Melo, A. A.; Spence, S. T. (Clarendon Lab., Oxford). pp 281-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The specific heats were measured of a series of Nb–W alloys. For the pure samples at low temperatures the superconducting electronic specific heat deviates from the BCS prediction in a way explained by a two-gap model. This effect of the second gap

is smaller for a tungsten concentration such that $l \approx \xi_0$, and is not observed for still shorter mean free paths. (auth)

6310 TRANSITION FROM STRONG- TO WEAK-COUPLING SUPERCONDUCTIVITY IN SOME NIOBIUM ALLOYS. Kimura, Y.; Ohtsuka, T.; Yamamoto, Y. (Electrotechnical Lab., Tokyo). pp 283-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The variations of some thermodynamic properties of superconducting Nb–Ta and Nb–Mo alloys with the electron–phonon coupling strength were investigated. Relevant properties were deduced from specific heat measurements of both the normal and superconducting states. The results are discussed in light of existing theories. (auth)

6311 ^{57}Fe MOESSBAUER EFFECT IN STRONG-COUPLED SUPERCONDUCTORS. Taylor, R. D.; Norvell, J. C.; Craig, P. P.; Kitchens, T. A. (Los Alamos Scientific Lab., N. Mex.). pp 285-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The recoil-free fraction and the line shift of dilute ^{57}Fe in V, Nb, Mo, Ta, and W were measured from $4 < T \leq 900$ K. A particular phonon average, of importance to the McMillan theory of strong-coupled superconductors, is determined for the impurity. The corresponding phonon average of the host is deduced from harmonic lattice theory and a new formulation of the impurity-host force constant. (auth)

6312 MAGNETIC FIELD INDUCED RESONANCE IN THE MICROWAVE ABSORPTION SPECTRUM OF IMPURE SUPERCONDUCTING ALUMINUM. Garfunkel, M. P.; Markley, R. W. (Univ. of Pittsburgh). pp 287-9 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics, Kyoto, Japan (4 Sep 1970). See CONF-700921.

The microwave surface-resistance spectrum of sufficiently impure superconducting aluminum shows a magnetic-field-induced peak near the energy gap. Using the Kronig–Kramers transforms with the surface resistance, the surface reactance is determined. From the surface impedance the bulk conductivity is approximated which, in the impure case, is seen to differ drastically from the BCS prediction. It is speculated that an appropriate magnetic-field dependence of the BCS coherence factors could explain the anomalous peak. (auth)

6313 PHONON CONTRIBUTION TO THE FAR-INFRARED ABSORPTIVITY OF SUPERCONDUCTING AND NORMAL LEAD. Joyce, R. R.; Richards, P. L. (Univ. of California, Berkeley). pp 291-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Measurements of the far-infrared absorptivity of superconducting and normal Pb show structure due to the Holstein phonon generation process. This structure is compared with a phenomenological theory, including the generation of the real acoustic phonon as the photon scatters a normal electron, or breaks a Cooper pair, and to a nonlocal calculation of the surface resistance from strong-coupling superconductivity theory. (auth)

6314 SUPERCONDUCTIVITY OF HIGH-PRESSURE PHASE OF TELLURIUM. Nakajima, T.; Kanda, E.; Ohki, Y. (Tohoku Univ., Sendai). pp 293-5 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The pressure dependence of the transition temperature of a high-pressure phase of Te was measured by means of the ice-bomb method. From the experimental results, it is felt that the superconductivity of the high-pressure phase of Te is an ordinary superconductivity as observed in nontransition-metal superconductors. (auth)

6315 PROXIMITY EFFECTS IN SUPERCONDUCTING ALUMINIUM–SILVER ALLOYS IN THE COOPER LIMIT. Blanc, J.; Nemoz, A.; Solecki, J. C. (CNRS, Grenoble, France). pp 297-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

During an isothermal aging of Al–Ag alloys which gives rise to the development of spherical Guiniel–Preston zones, the transition temperature and the thermodynamical critical field are constant and independent of aging, depending only on the initial concentration. The width of the transition remains narrow. These results are interpreted with a model of proximity effects, in three dimensions, in the Cooper limit. (auth)

6316 GENERALIZATION OF THE TIME-DEPENDENT GINSBURG–LANDAU EQUATIONS. Cyrot, M. (Faculte des Sciencses, Orsay, France). pp 299-300 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A generalization of the Ginzburg–Landau free-energy functional is derived first. Minimization of this functional with respect to the order parameter gives the Bogoluvbov self consistent equation. Near T_c it reduces to Ginzburg–Landau free energy. Then the time-dependent external field is added, and the time-dependent Bogolyubov equation is derived. Linearization with respect to the order parameter gives the usual time-dependent Ginzburg–Landau equations. (auth)

6317 PRESSURE EFFECT IN SUPERCONDUCTORS. Tamura, Y.; Wada, Y. (Tokyo Univ.). pp 301-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A new way of discussing the pressure effect is proposed for the simple superconductors on the basis of the Eliashberg–Nambu formalism. The expression for the variation of the transition temperature is directly obtained from the energy-gap equation. It can be shown to reduce to the corresponding expression derived from McMillan's formula for T_c, if the electron–phonon coupling is weak. (auth)

6318 CALCULATION OF PHONON EFFECTS ON THE ELECTRONIC PROPERTIES OF WHITE TIN. Balsey, J. F.; Swihart, J. C. (Indiana Univ., Bloomington). pp 303-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Using the pseudopotential model, the effect of the electron–phonon interaction on the electric resistivity, electron mass enhancement, and anisotropy of the superconducting energy gap of metallic tin is calculated. (auth)

6319 INVESTIGATION OF HIGHLY ANISOTROPIC SUPERCONDUCTORS (Zn AND Cd) BY LOW-TEMPERATURE SPECIFIC HEAT. Ducla-Soares, E.; Cheeke, J. D. N. (CNRS, Grenoble, France). pp 305-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Results on the specific heat of pure superconducting Zn and Cd from T_c down to ~0.1 K are presented. Using a 2-gap model for the mean square anisotropy, $\langle a^2 \rangle \sim 0.05$ for Cd and $\langle a^2 \rangle \sim 0.02$ for Zn are obtained. The results are interpreted in terms of a simple 2-gap model and compared with previous work. (auth)

6320 EFFECT OF NONLOCAL KERNELS OF GL EQUATIONS FOR SUPERCONDUCTORS WITH CUBIC SYMMETRY. Nagashima, T.; Takanaka, K. (Tohoku Univ., Sendai). pp 307-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A theoretical expression for H_{c2} and T_c involving four-term Kubic harmonics is derived for superconductors with cubic crystal symmetry. The result obtained is in substantial agreement with the observation of Farrell et al. It is found that the direction of the induced magnetic field is not parallel to that of the external magnetic field applied in an aribtrary direction. (auth)

6321 ANISOTROPIC UPPER CRITICAL FIELD OF PURE TYPE-II SUPERCONDUCTORS AT LOW TEMPERATURES. Takanaka, K. (Tohoku Univ., Sendai). pp 309-10 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The upper critical field, H_{c2}, appropriate for a pure single crystal with an anisotropic Fermi surface is calculated at low temperatures and is found to have a form $H_{c2}(0)\,(1 + \eta t^2 \ln t)$, where $t = T/T_c$. Coefficients $H_c^2(0)$ and η are anisotropic, reflecting the Fermi-surface anisotropy. This expression is a generalization of that for a spherical Fermi surface given by Gor'kov to anisotropic case. (auth)

6322 MULTIPARTICLE QUASI BOUND STATE NEAR SUPERCONDUCTING TRANSITION TEMPERATURE. Matsuno, K.; Stanley, H. E. (Massachusetts Inst. of Tech., Cambridge). pp 311-12 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

As the critical temperature of a superconductor is approached from above, the interaction between Cooper pairs cannot be neglected. The interaction can yield a two-Cooper-pair bound state. Although the collective excitation in the classical region of resistive transition is the Cooper pair, collective effects in Cooper pairs play dominant roles in the critical region. (auth)

6323 ELECTRON–PHONON INTERACTION IN DISORDERED SUPERCONDUCTORS AND THE ELIASHBERG FUNCTION $\alpha^2(E)F(E)$. Bergmann, G. (Kernforschungsanlage, Julich, Ger.). pp 313-14 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The electron–phonon processes in disordered superconductors do not necessarily conserve the lattice momentum. The change of the electron–phonon interaction is calculated for a simple model of a disordered superconductor and the Eliashberg function, $\alpha^2(E)F(E)$, is determined. For low energies, $\alpha^2(E)F(E)$ is proportional to the energy. This is in agreement with the experimental results and explains why disordered superconductors are strong coupling. (auth)

6324 SUPERCONDUCTING TRANSITION TEMPERATURES OF ALLOYS BASED UPON Nb_3Al. Cadieu, F. J.; Douglass, D. H. Jr. (Univ. of Rochester, N. Y.). pp 323-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The transition temperatures of alloys of $(Nb_{1-y}M_y)_3Al_{1-x}Ge_x$ were measured as a function of x and y, where M is one of the IVB transition metals Ti, Zr, or Hf. The variation of T_c is shown to be dominated by the transition-metal component in these systems. The higher T_c of Nb_3X systems, where X is a simple metal (s–p bonding) over the T_c of Nb alone is indicated to be due to the higher average phonon frequencies in Nb_3X systems. (auth)

6325 SUPERCONDUCTIVITY IN THIN FILMS OF HIGH-T_c COMPOUNDS. Hulm, J. K.; Gavaler, J. R.; Janocko, M. A.; Patterson, A.; Jones, C. K. (Westinghouse Research Labs., Pittsburgh). pp 325-7 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Data is presented on the superconducting behavior of sputtered thin films of NbN and $Nb_3(Al_{0.8}Ge_{0.2})$. High values of T_c, H_{c2}, and J_c were obtained for these films. The high critical current density is attributed to the small grain size coupled with the pinning of fluxoids at intergranular impurities or voids. (auth)

6326 SUPERCONDUCTING PROPERTIES OF NbN FILMS. Saito, Y.; Anayama, T.; Onodera, Y.; (and others) (Tohoku Univ., Sendai). pp 329-30 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

NbN films were prepared by reactive sputtering, and their superconducting properties were examined. NbN is a stong-coupling superconductor. NbN films prepared by reactive sputtering show high transition temperature, large critical current densities, and critical field compared to those of bulk. NbN films exhibit a large anisotropy in critical current with respect to the direction of the external magnetic field. (auth)

6327 INFLUENCE OF ATOMIC ORDERING ON ELECTRONIC PROPERTIES OF A15-TYPE ALLOYS. Heiniger, F.; Fluekiger, R.; Junod, A.; (and others) (Univ., Geneva). pp 331-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The low-temperature specific heats were measured in A15-type alloys of the composition $A_{1-\beta}B_\beta$ with Nb, V or Cr as an A element and Ru, Rh, Pd, Os, Ir, Pt, Au, Al, Si, Ga or Ge as a B element. It was concluded from the results that the electronic densities of states, like the superconducting transition temperatures, depend critically on the degree of long-range order. (auth)

6328 SUPERCONDUCTING PROPERTIES OF A15-PHASE V–Pt ALLOYS. Cox, J. E.; Hein, R. A.; Waterstrat, R. M. (Naval Research Lab., Washington, D. C.). pp 333-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Superconducting transition temperatures, T_0, and initial slopes of the critical magnetic field curves are reported for V–Pt alloys of the A15 crystal structure. Increased atomic ordering produces an increase in T_0, contrary to our previous results. (auth)

6329 SUPERCONDUCTIVITY IN SILVER. Deutscher, G.; Lindenfeld, P.; Wolf, S. (Rutgers–The State Univ., New Brunswick, N. J.). pp 335-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The transition of silver layers from the induced superconducting state to the normal state was studied by thermal conductivity measurements in S/N/S specimens. The curves of $(K_s/K_n)^{Ag}$ are consistent with the existence of two gaps, one of which is the same as determined by tunneling while the other corresponds to excitations traveling parallel to the boundary. The second gap leads to a value of $|NV|$ for silver of 0.11 ± 0.015. (auth)

6330 SUPERCONDUCTIVITY OF BERYLLIUM FILMS. Glover III, R. E.; Baumann, F.; Moser, S. (Univ. of Maryland, College Park). pp 337-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Beryllium films condensed on liquid-helium-cooled substrates were found to be superconducting, in agreement with earlier work. A transition temperature of 9.6 K, about a degree higher than found previously, was indicated by a rapid drop in resistance with cooling. Various experimental checks show that this behavior is characteristic of pure beryllium. (auth)

6331 SUPERCONDUCTIVITY OF AMORPHOUS GERMANIUM-ALLOY FILMS. Stritzker, B.; Wuehl, H. (Univ., Karlsruhe, Ger.). pp 339-40 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A metallic phase was obtained by condensation of Ge–noble metal metal alloys onto substrates held at approximately 4 K with concentrations of Cu, Ag or Au between 25 and 80 at. %. The superconductivity of this phase is believed to be due to Ge forced into a metallic, liquid-like structure, with a higher coordination number than that of the semiconducting diamond structure. (auth)

6332 SUPERCONDUCTING PROPERTIES OF TECHNETIUM SINGLE CRYSTALS. Kostorz, G.; Mihailovich, S. (Argonne National Lab., Ill.). pp 341-3 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Technetium single crystals were grown for the first time. Isothermal magnetization measurements in the superconducting state from 1.7 K to the critical temperature $T_c = (7.46 \pm 0.04)$ K are presented for two cylindrical single crystals with the axis parallel to $\langle 10\bar{1}0 \rangle$ and $\langle 0001 \rangle$. The results are compared with current theories and earlier work by Sekula et al. on polycrystalline material. (auth)

6333 EFFECTS OF SOME 3d AND 4d SOLUTES ON THE SUPERCONDUCTIVITY OF U_6Co AND UCo. Coles, B. R. (Imperial Coll. of Science and Tech., London). pp 345-6 of Proceedings of the Twelfth International Conference on Low Temperature

Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The effects of substitutions of Rh, Ni, Fe and Mn for Co and of Mo for U in the superconducting compounds of uranium and cobalt are reported. The Mo and Rh substitutions depress T_c strongly, while those of Fe and Mn raise T_c. The observations encourage speculations that f-electron character is important in this type of superconductivity and is assisted by exchange-enhancement effects on the cobalt sites. (auth)

6334 SPECIFIC HEAT AND SUPERCONDUCTIVITY OF Th–Y AND Th–La ALLOYS. Satoh, T.; Kumagai, K. (Tohoku Univ., Sendai). pp 347-9 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The low-temperature specific heats of Th–Y and Th–La alloys were measured in order to investigate the origin of the low Debye temperature θ_D of La and Th. The change of θ_D of Th–Y alloys with yttrium concentration is very similar to that of La–Y alloys. This result suggests that the origin of rather low θ_D of La and Th may be the same, and it is likely that the vacant 4f or 5f level just above the Fermi level is the cause of low θ_D. (auth)

6335 SUPERCONDUCTIVITY AND MAGNETISM IN COMPOUNDS OF LANTHANUM WITH TIN AND INDIUM. Toxen, A. M.; Gambino, R. J. (IBM Watson Research Center, Yorktown Heights, N. Y.). pp 351-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Measurements of superconducting critical temperature, specific heat, susceptibility, and Knight shift were carried out on the system $La(In_xSn_{1-x})_3$. A sharp drop in critical temperature in the range $0 < x < 0.15$ is shown to be due to a decrease in density of states with the electron–phonon interaction remaining constant. The susceptibilities and Knight shifts are complex and not well understood. (auth)

6336 OSCILLATORY DEPENDENCE OF SUPERCONDUCTIVE CRITICAL TEMPERATURE ON NUMBER OF VALENCY ELECTRONS IN ALLOYS OF MAINLY NONTRANSITION METAL COMPOUNDS. Havinga, E. E.; van Maaren, M. H. (Philips Research Labs., Eindohoven, Netherlands). pp 355-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

It is shown that the critical temperature of a nontransition metal superconductor is, in general, an oscillatory function of the valency. The experimental evidence is obtained in a large number of alloy systems, having sc, fcc, Cu_3Au, or $CuAl_2$ structure. A qualitative explanation in terms of Brillouin-zone effects is presented. (auth)

6337 CRITICAL CARRIER CONCENTRATION FOR SUPERCONDUCTIVITY IN MIXED METAL–SEMICONDUCTOR SYSTEMS. van Maaren, M. H.; Harland, H. B.; Havinga, E. E. (Philips Research Labs., Eindhoven, Netherlands). pp 357-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The appearance of superconductivity in the systems $CuRh_{2-x}Sn_xSe_4$ and $Rh_{1-x}Ru_xSe_2$ coincides with anomalies in the normal Hall coefficient. The strong increase of the electronic heat-capacity coefficient in the superconducting part of the system appears to be entirely caused by phonon enhancement. The results imply that superconductivity occurs only if both electrons and holes are present at the Fermi surface. (auth)

6338 SUPERCONDUCTIVITY OF Rb_xWO_3. Shanks, H. R.; Danielson, G. C. (Iowa State Univ., Ames). pp 359-60 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Superconductivity in Rb_xWO_3 was discovered by Sweedler et al. The transition temperature was measured as a function of rubidium concentration from $x = 0.26$ to $x = 0.33$. Rubidium concentrations were determined by neutron-activation analysis. From $x = 0.26$ to $x = 0.33$, the transition temperature increased from 1.6 K to 2.0 K. (auth)

6339 THEORY OF LAYER-STRUCTURE SUPERCONDUCTORS. Lawrence, W. E.; Doniach, S. (Stanford Univ., Calif.). pp 361-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A model for superconducting layer compounds is studied in which the Ginzburg–Landau order parameter in adjacent layers is coupled by Josephson tunneling. To illustrate the dependence of properties on layer spacing, which can be varied experimentally, the frequency of the characteristic Josephson plasma resonance that should be exhibited at low temperatures, the anisotropy of critical fields H_{c1} and H_{c2}, and the fluctuation-induced conductivity for temperatures above T_c are discussed. (auth)

6340 PINNING OF FLUX LINES IN SUPERCONDUCTING NIOBIUM DUE TO POINT DEFECTS. Ullmaier, H.; Papastaikoudis, C.; Takacs, S.; Schilling, W. (Kernforschungsanlage, Julich, Ger.). pp 369-70 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Measurements of pinning forces due to statistically distributed vacancies and interstitials (Frenkel pairs) in niobium are reported. The defects were produced by low-temperature 3-MeV electron irradiation. The field and concentration dependence of the pinning forces indicates that fluctuations in the defect density are responsible for the observed pinning effects. (auth)

6341 FLUX PINNING IN HETEROGENEOUS LEAD–SODIUM ALLOYS. Freyhardt, H. C.; Petermann, J.; Haasen, P. (Univ., Gottingen, Ger.). pp 371-3 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Interactions between fluxoids and Pb_3Na precipitate particles were investigated in single crystals of a type-II superconducting Pb–7 at. % Na alloy. The maximum interaction force between one fluxoid and one precipitate was determined and compared with models for flux pinning by precipitates. Single crystals containing large needle-shaped precipitates showed a magnetically anisotropic behavior, whereas crystals with small spherical particles were found to be magnetically isotropic. (auth)

6342 SURFACE FLUX PINNING IN LOW-κ TYPE-II SUPERCONDUCTORS. Doidge, P. R.; Eastham, A. R. (Univ. of Surrey, Guilford). pp 375-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Direct evidence for surface pinning of fluxoids in rod samples of low-κ type-II superconductors is presented. Axial magnetization gradients were measured, and are dependent on applied field and on the nature of the specimen surface. A thermodynamic argument justifies the idea of a surface critical state and indicates that the diamagnetic traversals of minor-hysteresis loops are a consequence of surface pinning. (auth)

6343 DEPENDENCE OF SURFACE RESISTANCE OF SUPERCONDUCTORS ON MEAN FREE PATH AT LOW FREQUENCIES AND LOW TEMPERATURES. Halbritter, J. (Univ., Karlsruhe, Ger.). pp 377-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Through the achievement of low residual surface resistance, it has become possible to test the BCS theory. One of the most peculiar features at low rf field levels is the dependence of the surface resistance $R = R(l)$ of superconductors on mean free path l. Starting from $l = \infty$, $R(l)$ first decreases with decreasing mean free path, has a minimum at $l \approx \xi$ (coherence length), and increases afterwards. This predicted behavior was confirmed by measurements of Flécher. The decrease of $R(l)$ (by a factor larger than 3) is most pronounced in materials with short coherence length $\xi(l = \infty)$ and frequencies well below the energy gap. This behaviour shows the possibility of lowering the rf absorption by using alloys of Nb or Pb. (auth)

6344 PINNING FORCE IN SOLID-SOLUTION ALLOYS OF THE Nb–Hf SYSTEM. Bethoux, O.; Guerin, J. Y. (CNRS, Grenoble France). pp 379-80 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The superconducting properties of solid-solution alloys of the Nb–Hf system containing up to 70 at. % Hf were measured as a function of the structural state. The variations of the pinning-force density (calculated from magnetization measurements) with composition and heat-treatments are discussed on the basis of the existing pinning models. (auth)

6345 ION IMPLANTATION AS METHOD OF STUDYING AND CONTROLLING SURFACE SUPERCONDUCTIVITY. Chang, C. C.; Rose-Innes, A. C. (Univ. of Manchester, Eng.). pp 381-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Ion-implantation was used to alter, in a controlled manner, the composition of the surface of a type-II superconductor. This allows the study of the effect of surface superconductivity on the critical current. The experimental results confirm that the critical current of very pure samples in the mixed state is determined by pinning of fluxons at surfaces to which they lie parallel. (auth)

6346 INFLUENCE OF PHYSICAL IMPERFECTIONS CAUSED BY COLD ROLLING AND NEUTRON IRRADIATION ON TYPE II SUPERCONDUCTORS. de Klerk, D.; van der Klein, C. A. M.; Elen, J. D. (Kamerlingh Onnes Lab., Leiden). pp 383-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

An investigation was made of the influence of cold rolling, heat treatment, and neutron irradiation on the superconducting properties of chemically very pure niobium. The susceptibility behavior of samples with a dense defect structure can be described by means of surface effects. For samples with a relatively high degree of physical perfection bulk effects also play an important role. (auth)

6347 MAGNETIC INSTABILITIES IN HIGH-FIELD SUPERCONDUCTORS. Ogasawara, T.; Yasukochi, K.; Akachi, T. (Nihon Univ., Tokyo). pp 385-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

In the isothermal magnetization process of a cylindrical specimen of high field superconductor Nb–50 at. % Ti, the magnetic instability is induced artificially by the application of small pulsive magnetic field. The field for stability limit as a function of temperature is quantitatively explained on the basis of the critical-state model by due consideration of the relation between the magnetic diffusivity and the thermal diffusivity. (auth)

6348 CRITICAL CURRENT–LONGITUDINAL MAGNETIC FIELD CHARACTERISTICS OF TYPE-II SUPERCONDUCTORS. Yasukochi, K.; Ogasawara, T.; Kubota, Y.; Maruyama, K. (Nihon Univ., Tokyo). pp 387-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

In the longitudinal configuration of transport current and magnetic field H, the critical current I_c and the destruction current I_N are determined on cylindrical specimens of type-II superconductor, Nb–83 at.% Ta. I_c vs. H characteristic is understood by the consideration of the balance between the flux line tension and the pinning force. However, a considerable discrepancy between experiment and theory is shown in I_N vs. H curve. (auth)

6349 INVESTIGATION OF THE AC LOSS MECHANISM BELOW H_{c1} IN A TYPE-II SUPERCONDUCTOR. Brankin, P. R.; Rhodes, R. G. (Univ. of Warwick, Eng.). pp 389-90 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Measurement of the ac losses in niobium samples below H_{c1} was made as a function of the frequency of the applied field, the trapped flux, and surface roughness. Evidence is presented that the losses arise from flux penetration at surface asperities and from trapped flux in the material. (auth)

6350 RE-EXAMINATION OF TRANSPORT PROPERTIES OF DIRTY TYPE-II SUPERCONDUCTORS. Ebisawa, H.; Takayama, H. (Tokyo Univ.). pp 397-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The vortex motion in dirty type-II superconductors is discussed through the time-dependent GL equation in the high-field region, $H \simeq H_{c2}$. The correct treatment of the effect of the applied electric field is essential. The flow resistivity and the Hall conductivity are calculated and the results by Caroli and Maki are revised. Thermal gradient does not move the vortex pattern. (auth)

6351 FLUX-FLOW RESISTANCE AND HALL EFFECT IN TYPE-II SUPERCONDUCTORS. Noto, K.; Muto, Y. (Tohoku Univ., Sendai). pp 399-400 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Flux-flow resistance and the Hall effect were measured on pure and dirty type-II superconductors in wide temperature regions. It has turned out that, in pure Nb, behaviors of both flux-flow resistance and Hall angle depend strongly on the mean free path, while flux-flow resistance of three dirty alloys and Hall angle of $Nb_{80}Mo_{20}$ alloy are well explained by recent theories based on time-dependent Ginzburg–Landau equations. (auth)

6352 VORTEX MOTION IN DIRTY TYPE-II SUPERCONDUCTORS. Muto, Y.; Noto, K.; Mori, K. (Tohoku Univ., Sendai). pp 401-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The Ettingshausen effect and the thermal conductivity measured on $Nb_{80}Mo_{20}$, $Nb_{75}Mo_{25}$ and $Nb_{80}Ta_{20}$ alloys are compared with the microscopic theory on the vortex motion in the mixed state in the dirty type II superconductor. It is found that the entropy carried by a vortex line may become zero at 0°K. (auth)

6353 ENTROPY OF VORTICES AND SPECIFIC HEAT IN THE SUPERCONDUCTING MIXED STATE. Ehrat, R.; Rinderer, L. (Univ., Lausanne, Switzerland). pp 403-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Experimental results of specific heat as well as of incremental entropy of vortices obtained on a highly reversible type-II superconducting alloy ($Nb_{80}Mo_{20}$*) are compared with theoretical values calculated from the Abrikosov free energy. Special attention is paid to the mixed–normal state specific heat jump in low magnetic field within the critical temperature, where an anomalous behavior occurs. (auth)

6354 FLUX FLOW IN TYPE-I AND -II SUPERCONDUCTING FILMS. Ogushi, T.; Takayama, T.; Shibuya, Y. (Kyushu Univ., Fukuoka). pp 405-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The flux flow in superconducting thin films was measured as a function of thickness and of mean free path. The critical thickness dividing the thickness-region into two parts, i.e., the region of the vortex state and that of the intermediate state, is compared with the theoretically predicted one. The nonlinearity in the V–I plots is discussed in terms of the vortex lattice instability. (auth)

6355 MAGNETIC FLUX QUANTIZATION IN SINGLY CONNECTED SUPERCONDUCTING CYLINDERS. Shablo, A. A.; Dmitrenko, I. M. (Physico-Technical Inst. of Low Temperatures, Kharkov). pp 407-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The new effect of oscillations of the critical temperature in solid cylinders was investigated experimentally near T_c in a parallel magnetic field. The qualitative and quantitative agreement with theoretical models, using the notion of the magnetic flux quantization by surface superconductivity currents, is observed. The oscillations remain at $ae < 0.4$, which is accounted for by specimen supercooling below the thermodynamic critical field. (auth)

6356 INDIVIDUAL VORTEX MOTION STUDY IN TYPE-II SUPERCONDUCTORS. Baixeras, J.; Pech, T. (Faculte des Sciences de Paris, Fontenay-aux-Roses, France). pp 409-11 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

An original method is proposed for the detection of vortex motion in one particular point of a superconductor. This method is based on the use of a point contact Josephson junction placed in the point under consideration. The critical current of the junction is modulated by the passage of the vortices. The results of the preliminary experiments clearly show the existence of the predicted effect. (auth)

6357 THEORY OF FLUX-FLOW NOISE VOLTAGE AND CROSSPOWER SPECTRA IN SUPERCONDUCTORS. Clem, J. R. (Iowa State Univ., Ames). pp 413-14 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A theory of flux-flow voltage noise is used to discuss the dependence of the experimentally measurable two-contact power spectrum or four-contact crosspower spectrum upon the time evolution of the moving flux-line distribution. Theoretical power spectra and crosspower spectra are computed for a random distribution of flux lines moving rigidly across a superconducting strip. (auth)

6358 FLUX TRANSPORT NOISE IN NIOBIUM FOILS. Kruger, J. B.; Heiden, C. (Univ. of California, Berkeley). pp 415-16 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Flux transport in Nb foils is investigated by analyzing the associated noise. Its intensity below the λ point indicates a rather coherent motion of fluxons. Moving fluxons appear less correlated at 4.2K due to thermal effects, but a considerable correlation of transport fluctuations throughout the foil is revealed by cross power spectra from widely separated contact pairs. (auth)

6359 VERIFICATION OF BURGESS' THEORY OF FLUX-FLOW NOISE SPECTRUM OF TYPE-II SUPERCONDUCTORS. Shen, S. W.; van der Ziel, A. (Univ. of Minnesota, Minneapolis). pp 417-18 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Burgess' theory of flux flow noise in Type-II superconductors is modified to take into account the finite width of the superconducting foils used in the experiment. After this modification, good agreement between theory and experiment is obtained for the linear V–I region of the sample. (auth)

6360 TUNNELING MEASUREMENTS IN SUPERIMPOSED LAYERS OF Al AND Sn. Vrba, J.; Woods, S. B. (Univ. of Alberta, Edmonton). pp 419-20 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The tunneling conductance of junctions formed between superconducting aluminum and the N-side of N/S (aluminum/tin) proximity sandwiches was measured. The coupling between the N and S films was made weak by allowing slight oxidation to occur at the interface. The action of the oxide is associated with the barrier in McMillan's tunneling model of the superconducting proximity effect. Calculations performed with his model agree well with the experimental results. (auth)

6361 TUNNELING INTO SUPERCONDUCTING RHENIUM SINGLE CRYSTALS. Ochiai, S. I.; MacVicar, M. L. A.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge). pp 421-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The energy gap for superconducting rhenium was determined as a function of orientation by tunneling into single crystals through carbon barriers. Considerable anisotropy was observed, $2\Delta(0)/K_BT_C$ varying from 2.79 ± 4% to 3.91 ± 2%. Multiparticle data did not agree with single-particle data, but all exhibited the BCS temperature dependence within 2% and cut off sharply at H_c. (auth)

6362 MAGNETIC FIELD AND SUPERCONDUCTING TUNNEL JUNCTION CHARACTERISTIC WITH A NON-CONVENTIONAL INSULATOR. Faraci, G.; Gaiquinta, G.; Mancini, N. A.; Quercia, I. F. (Univ., Catania, Italy). pp 423-5 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Superconducting tunnel junctions were realized with a non-conventional insulator (Formvar) whose thickness is quite small (10 Å to 50 Å). The value obtained for the gap parameter of lead, observable from the tunneling characteristics, is in a good agreement with the law of the corresponding states. Large, asymmetric junctions ($w \sim L > \lambda_J$, λ_J Josephson penetration depth, thickness of the insulator ~ 10 Å) show a value of the switch potential (0.15 mV) in agreement with theoretical calculations performed by Kulik. The dependence of the characteristics on the magnetic field is discussed. (auth)

6363 MEASUREMENT OF TUNNEL CURRENT DENSITY IN A METAL/OXIDE/METAL SYSTEM AS A FUNCTION OF OXIDE THICKNESS. Eldridge, J. M.; Matisoo, J. (IBM Watson Research Center, Yorktown Heights, N. Y.). pp 427-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Pb/PbO/Pb tunnel junctions were fabricated under ultrahigh vacuum (< 10^{-9} torr) conditions. The Pb oxidation kinetics were studied in situ ellipsometrically for thicknesses of < 30Å. In this range the oxide thickness goes $d_{ox} = a \ln t + b$. The zero temperature Josephson current density, j_1, for these junctions is given by $j_1 \cong 1.5 \times 10^9 \exp(-d_{ox}/1.5A)$ (A/cm²). (auth)

6364 LOW-TEMPERATURE TUNNELLING STUDY OF VORTICES IN SUPERCONDUCTING THIN FILMS. Donaldson, G. B.; Brassington, D. J. (Univ. of Lancaster, Eng.). pp 429-31 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The density of states of bound excitations in isolated vortices induced in thin super-conducting aluminum films was studied using superconducting tunneling at low biases and low reduced temperatures. The sizes of the vortex cores and electromagnetic regions are consistent with the theory of Pearl. Other results suggest that cores are not well localized within vortices. (auth)

6365 SUPERCONDUCTIVE TUNNEL JUNCTIONS AS DETECTOR OF INCOHERENT HIGH-FREQUENCY PHONONS. Schulz, J. P.; Weis, O. (Univ., Heidelberg). pp 433-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The change of the current–voltage characteristics of a Sn/I/Sn superconductive tunnel junction under irradiation of acoustic THz phonons is described. (auth)

6366 JOSEPHSON CURRENT THROUGH A JUNCTION WITH NORMAL-METAL BARRIER. Ishii, C. (Tokyo Univ.). pp 435-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Josephson current through a junction with thick normal-metal barrier is calculated as a function of the assumed relative phase between superconductors. It is shown that multiple tunneling processes of Cooper pairs contribute to higher harmonic phase-dependent terms and produce a piecewise linear current/phase relation. (auth)

6367 JOSEPHSON JUNCTIONS WITH SUPERCONDUCTING BARRIERS. Yamafuji, K.; Ezaki, T.; Matsushita, T.; Irie, F. (Kyushu Univ., Fukuoka). pp 437-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Dc characteristics of Josephson junctions with thin superconducting barriers are discussed with the aid of the Ginzburg–

Landau equations. The main difference of the present junctions from the Josephson junctions proposed so far lies in the fact that the barrier is composed of a thin type-II superconductor in the superconducting state. (auth)

6368 JOSEPHSON JUNCTIONS WITH SUPERCONDUCTING BARRIERS. II. EXPERIMENT. Mitani, M.; Aihara, K.; Hara, N. (Central Research Lab., Tokyo). pp 439-40 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Some experimental results are presented on a new type of Josephson junction proposed by Yamafuji et al. Its configuration is Pb/Pb-In/Pb and the possibility of the existence of an oxide layer in the Pb-In alloy layer is discussed. X-band microwave radiation emitted from this junction was detected at power levels of more than 10^{-11} watts. (auth)

6369 SUPERCURRENT THROUGH S/N/S SANDWICH. Kobayashi, S.; Sato, M.; Sasaki, W. (Tokyo Univ.). pp 441-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Maximum supercurrents I_c through Pb/Cu/Sn junctions are measured as a function of temperature in the G-L region of Sn. The observed variation of I_c is linear with T as expected. A rapid increase of I_c is observed for relatively thin Cu films just below T_c of Sn. (auth)

6370 ELECTRIC TRANSPORT CURRENTS ACROSS NORMAL SUPERCONDUCTING INTERFACES. Clarke, J. (Univ. of California, Berkeley). pp 443-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The electric resistance of Pb-Bi/Cu/Pb-Bi sandwiches is independent of temperature in the range 1 to 4K whereas that of Pb-Bi/Cu/Pb-Bi drops markedly. The resistance of the Zn junctions is strongly dependent upon current and magnetic field, whereas that of the Cu junctions is not. (auth)

6371 RADIATIVE EMISSION FROM N/S POINT CONTACTS. Gregory, W. D.; Leopold, L.; Bostock, J.; Averill, R. F.; Repici, D. (Georgetown Univ., Washington, D. C.). pp 445-7 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Energy-gap radiation was generated using specially formed Ta(S)/Al(N) point contacts. Power output, threshold tunnel current, temperature dependence of the radiation frequency, the effect of junction geometry and other data support a model for the radiation based on stimulated emission during pairing. The radiation was detected at room temperature using a special cryostat. I-V curves suggest the junctions are weak links. (auth)

6372 INTERACTION OF MICROWAVES WITH POINT-CONTACT JOSEPHSON-JUNCTION ARRAYS. Clark, T. D. (Philips Research Labs., Eindhoven, Netherlands). pp 449-51 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

External microwave radiation ($\nu \sim 9.2$ GHz) is found to induce current steps in the I versus V characteristics of Nb point-contact Josephson junction arrays, at voltage intervals of $m \times h\nu/2e$, where m is the number of junction across the array. This implies that the microwave field is forcing all the junctions in the array into synchronization. (auth)

6373 ELECTRODYNAMIC AND NOISE PROPERTIES OF VERY SMALL JOSEPHSON TUNNEL JUNCTIONS. Buckner, S. A.; Chen, J. T.; Langenberg, D. N. (Univ. of Pennsylvania, Philadelphia). pp 453-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The dc current-voltage characteristics of very small Josephson tunnel junctions (linear dimensions less than 10^{-5} cm) were studied, including the effect of external noise. The results are in good qualitative and quantitative agreement with the theoretical predictions of Ivanchenko and Zil' berman. (auth)

6374 NOISE IN JOSEPHSON POINT CONTACTS. Kanter, H.; Vernon, F. L. Jr. (Aerospace Corp., El Segundo, Calif.). pp 455-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Experimental evidence supports the dependence and magnitude of noise currents in superconducting point contacts on dc current and voltage as predicted by Scalapino and Stephen. Approximate calculations are made of the minimum amount millimeter-wave power detectable with these devices against their noise level. Only the video detection made is considered. (auth)

6375 COMPLETE ELECTROMAGNETIC SOLUTIONS IN LONDON APPROXIMATION FOR RADIATING JOSEPHSON'S JUNCTIONS. Renard, M. (Centre D'Etudes Cryogeniques de L'Air Liquide, Sassenage, France). pp 457-9 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

An attempt is made to find equations for the electromagnetic propagating solutions inside a Josephson plane junction. Let x and y be the coordinates parallel to the plane and z being perpendicular. Essentially plane-wave-like solutions are looked for and the propagating vector is taken parallel to x, so y does not appear explicitly in the equations. The Ferrell and Prange equation was found as the low frequency limit of the true equation. (auth)

6376 FLUX MOVEMENT IN TYPE-I AND TYPE-II SUPERCONDUCTORS. Wright, L. S.; Baird, D. C.; Wertheimer, M. R. (Royal Coll. of Canada, Kingston, Ont.). pp 465-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A film is presented showing (a) magnetic flux penetration into Type-I superconducting cylinders and the effect of impurities on the penetration pattern and (b) a flux jump in a Type-II superconductor with particular emphasis on the thermal dissipation caused by the flux jump. (auth)

6377 MAGNETO-OPTICAL OBSERVATION OF MAGNETIC FLUX STRUCTURES IN SUPERCONDUCTORS. Huebener, R. P.; Rowe, V. A.; Kampwirth, R. T. (Argonne National Lab., Ill.). pp 467-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The magnetic flux structure in superconducting niobium foils and lead films was studied using the high specific Faraday rotation at low temperatures in thin films of a mixture of EuS and EuF_2. The trapped flux often consists of very large domains, the arrangement of which is closely related to the sample shape. (auth)

6378 KINETICS OF THE DESTRUCTION OF TYPE-I SUPERCONDUCTIVITY BY A CURRENT. Posada, E.; Rothen, F.; Bestgen, W.; Rinderer, L. (Univ., Lausanne, Switzerland). pp 469-70 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The kinetics of the destruction of Type-I superconductivity in a cylindrical wire by a current were studied. A comparison between theoretical and experimental values of the transition time is given. (auth)

6379 FIELD PENETRATION INTO TYPE-I SUPERCONDUCTING CYLINDERS. Olafsson, R.; Allen, J. F. (St. Andrews Univ., Scotland). pp 471-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The initial-field penetration region is shown to consist of an intermediate state of radial laminae. The laminae advance with increasing applied field until the intermediate state-superconducting interface just penetrates the equator. The average spacing of the laminae is principally determined by the surface energy. (auth)

6380 INTERMEDIATE STATE IN TYPE-II SUPERCONDUCTORS. Kraegeloh, U.; Kumpf, U.; Seeger, A. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 473-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Direct observations of the magnetic structure and measurements of magnetization curves show that Pb–Tl alloys exhibit a type-II intermediate state. The interphase energy between Meissner and Shubnikov domains coincides at $\kappa = 2^{-\frac{1}{2}}$ with that of Meissner–normal interfaces, which remains positive in violation of the Ginzburg–Landau equations. Well-defined initial flux densities and lattice parameters in the flux-line lattices demonstrate than an attractive interaction between the flux-lines exists. (auth)

6381 CURRENT-INDUCED FLOW OF SUPERCONDUCTING DOMAINS. Solomon, P. R.; Harris, Richard E. United Aircraft Research Labs., East Hartford, Conn.). pp 475-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Current-induced flow of superconducting domains with velocity similar to that of normal domains (flux flow) was observed in the intermediate state of bulk type-I superconductors. The characteristics of superconducting domain flow are described and compared with those of normal domain flow. (auth)

6382 TRANSPORT CURRENT DISTRIBUTION AND DEFORMATION OF THE VORTEX LATTICE STRUCTURE IN A TYPE-II SUPERCONDUCTOR. Thorel, P.; Simon, Y. (Ecole Normale Superieure, Paris). pp 477-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

By probing the magnetic field b(r) due to the transport current around samples of rectangular cross section, it is inferred that a current less than critical flows as a surface current leaving the vortex structure unperturbed. When a voltage appears, the current begins to penetrate the entire volume. Besides, neutron-diffraction experiments reveal that, under conditions of flux flow, the triangular lattice persists with improved order. (auth)

6383 DESTRUCTION OF SUPERCONDUCTIVITY BY A CURRENT. Mukherjee, B. K.; Wiederick, H. D.; Baird, D. C. (Royal Coll., Kingston, Ont.). pp 479-80 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The model of the intermediate state in current carrying Type-I superconductors is revised. Several other models have also been put forward. These models are compared on the basis of evidence from three different kinds of experiments. (auth)

6384 S–N TRANSISTION OF NONIDEAL TYPE-II SUPERCONDUCTING Ta. Koga, S.; Shibuya, Y. (Kyushu Univ., Fukuoka). pp 481-2 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The S–N transition caused by a pulse current of rectangular form was investigated. The current dependence of the potential drop V_1 initially observed can be understood qualitatively in terms of the flux creep-flow theory by Y. B. Kim and P. W. Anderson. The potential drop V_1 was decreased by a longitudinal magnetic field H_e. (auth)

6385 HIGH-FIELD SUPERCONDUCTING PROPERTIES OF LAVES PHASES IN V–Hf AND V–Hf–Zr ALLOYS. Inoue, K.; Tachikawa, K. (National Research Inst. for Metals, Tokyo). pp 483-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The maximum transition temperature 10.1°K is obtained in V–Hf–Zr ternary alloys at the composition of $V_2Hf_{0.5}Zr_{0.5}$. Resistive critical fields, H_r, of $V_2Hf_xZr_{1-x}$ alloys well exceed 200 kOe at 4.2°K in the composition range of $x > 0.3$. Electronic specific heat coefficients, γ, of V_2Hf was 2.1×10^4 erg/cm^3 deg^2 and that of $V_2Hf_{0.5}Zr_{0.5}$ was 2.8×10^4 erg/cm^3 deg^2. This large γ and spin–orbit scattering may cause high H_r in these alloys. (auth)

6386 BULK GRANULAR SUPERCONDUCTORS. Cortes, H.; Pellan, P.; Rosenblatt, J. (Institut National des Sciences Appliquees, Rennes, France). pp 487-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A bulk granular superconductor is a three-dimensional array of superconducting grains linked to each other through Josephson junctions. Such a system, containing about 10^4 point contacts, shows a transition to the coherent (resistanceless) state at a temperature much smaller than the superconducting transition temperature of isolated grains. (auth)

6387 ORDER-PARAMETER MEASUREMENTS ON SUPERCONDUCTING ALUMINUM THIN FILMS. Rose, D. K. (Stanford Univ., Calif.). pp 489-91 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The imaginary component of the conductivity of superconducting aluminum thin films was measured as a function of current and temperature. The method consisted of monitoring a low frequency resonant circuit. The resolution was sufficient to observe an 0.1% change in the zero-degree order parameter. Quantitative observations were made of the suppression of the order parameter with current. The results are in excellent agreement with Landau–Ginzburg theory. The size of the suppression effect is a good measure of the true depairing current density. The temperature variation of the conductivity is in good agreement with the two fluid model. (auth)

6388 STABILITY OF SUPERCURRENT FLOW IN CYLINDRICAL FILMS OF TIN. Meissner, H. (Stevens Inst. of Tech., Hoboken, N. J.). pp 493-5 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Supercurrents in thin films of tin are found to be metastable. For square current pulses, a voltage appears which rises with time t approximately as $V = a[1 - \mathrm{erf}\,(t'/2(t-c))^{\frac{1}{2}}]$. Over a range from a fraction of one nanosecond to several hundred nanoseconds t' is an exponentially decreasing function of $i[1 + 420/d]/[1 - (T/T_c)^4]$ for cylindrical films and of $J[1 + (420/d)]/[1 - (T/T_c)^4]$ $[1 - H_\perp/H_{c1}]$ for flat films in a perpendicular magnetic field. (i = current, J = current density). (auth)

6389 SURFACE IMPEDANCE OF THIN SUPERCONDUCTING FILMS IN A PARALLEL FIELD. Holzer, W.; Waysand, G.; Guyon, E. (Faculte des Sciences, Orsay, France). pp 497-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Results are reported of the anisotropy of the surface impedance of In Bi films in a dc parallel as function of thickness. The anisotropy $\tilde{\gamma}$ is large when the film can just accommodate vortices (first entry field). The relevant models for the geometrical arrangement are discussed. (auth)

6390 KONDO EFFECT IN NORMAL METALS AND IN SUPERCONDUCTORS. Zittartz, J. (Univ., Cologne). pp 647-50 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The theoretical aspects of the Suhl–Nagaoka approach to the Kondo problem in normal metals and in superconductors are discussed. In particular, the origin of the Kondo anomalies in typical normal-metal properties, as well as its extension to the case of superconductors, is described. (auth)

6391 KONDO EFFECT IN SUPERCONDUCTORS AND NORMAL METALS. Nagaoka, Y. (Nagoya Univ., Japan). pp 651-5 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A magnetic impurity in a superconductor is investigated using the Yosida theory on the singlet bound state, and the results are compared with Zittartz and Mueller–Hartmann's calculation by the Green's-function theory. The behavior of a discrete level (triplet for $J > 0$ and doublet for $J < 0$) in the energy gap is ex-

amined and it is found that for $J < 0$ a serious discrepancy appears between two theories, when $|J|$ is large. (auth)

6392 SUPERCONDUCTIVE TRANSITIONS SUITABLE AS THERMOMETRIC FIXED POINTS. Schooley, J. F.; Soulen, R. J. Jr. (National Bureau of Standards, Washington, D. C.). pp 833-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

It was found that annealed wire samples of Pb, In, Al, Ga, and Zn, when simply prepared and mounted, exhibit superconductive transitions using ac susceptibility techniques that are sharper than one millikelvin. These transitions are reproducible to a millikelvin after many thermal cycles over a twenty-month period, suggesting their use as thermometric fixed points. (auth)

6393 ENERGY LOSS AT VERY LOW FREQUENCIES IN SUPERCONDUCTING LEAD. Williams, G. A.; Skinner, R. H. (Univ. of Utah, Salt Lake City). pp 871-3 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

A technique was developed for measuring energy losses in a superconducting sample moving in an external magnetic field at frequencies as low as 0.05 Hz. At a frequency of 1 Hz, the technique is sensitive to energy losses in this mode at least 10^{-13} watts. A superconducting sphere is suspended by a quartz fiber to form a torsion pendulum whose period can be between 0.1 and 20 sec. The sample is placed in an external fixed magnetic field and the Q of the torsion pendulum measured. Results on single crystal lead as a function of magnetic field and temperature are reported. A peak in energy loss at the transition to the superconducting state is found. (auth)

6394 ^{14}N NUCLEAR QUADRUPOLE RESONANCE IN COMPOUNDS USED AS INTERCALATES IN SUPERCONDUCTING COMPLEXES OF TaS_2. Bray, P. J.; Sauer, E. G. (Brown Univ., Providence). Solid State Commun.; 11: No. 9, 1239-43(1 Nov 1972).

The nitrogen quadrupole resonance (NQR) frequencies of nitrogen-containing organic molecules are found to correlate with the enhancement in the superconducting critical temperature T_c caused by intercalating these molecules in layered tantalum disulfide ($2H-TaS_2$). This correlation of NQR frequencies (measured before intercalation) with T_c provides a basis for predicting T_c values for molecules with known charge distribution, determining the details of charge transfers from intercalate to layered chalcogenide, and selecting intercalates which may achieve optimal values of T_c. (auth)

6395 INTERMEDIATE MIXED STATE MAGNETIZATION MEASUREMENTS. Rothwarf, F.; Rao, C. T.; Dubeck, L. W. (Army Electronics Labs., Fort Monmouth, NJ). Solid State Commun.; 11: No. 9, 1123-5(1 Nov 1972).

Magnetization measurements on Pb–Tl and niobium samples with the Ginzburg–Landau parameter κ between 0.71 and 1 demonstrate the behavior to be expected of a sample in the intermediate–mixed state of Type II superconductors. In particular, the magnetization curve is intrinsically irreversible. (auth)

6396 MAGNETIC FIELD DEPENDENCE OF THE SUPERCONDUCTING FLUX FLOW RESISTANCE MINIMUM. Joiner, W. C. H.; Thompson, J. (Univ. of Cincinnati, OH). Solid State Commun.; 11: No. 10, 1393-5(15 Nov 1972).

Measurements were made in lead alloys of the field dependence of the temperature, T_{min}, at which the superconducting flux flow resistivity passes through a minimum. When the data are expressed in terms of the reduced variables $t_{min} = T_{min}/T_c$ and $h = H/H_{c2}(0)$, t_{min} is the same linear function of h for all samples. The slope dt_{min}/dh is -0.72, indicating a stronger influence of magnetic field on t_{min} than in recent calculations by Chow (Phys. Rev., 188: 783(1969) and Phys. Rev., B1: 2130(1970)). (auth)

6397 SPECIFIC HEAT OF THE SUPERCONDUCTING-KONDO SYSTEM $(La,Ce)Al_2$. Luengo, C. A.; Maple, M. B.; Fertig, W. A. (Univ. of California, La Jolla). Solid State Commun.; 11: No. 10, 1445-50(15 Nov 1972).

Specific heat measurements between 0.5 and 4.2°K on the system $(La, Ce)Al_2$ in the normal and superconducting states are reported. In the normal state, the Ce impurities cause a strong enhancement of the electronic specific heat coefficient γ_N and an exchange scattering anomaly which varies as $(-\ln T)$ between 0.5 and 2.5°K. Both effects scale with Ce concentration. The specific heat jump at the superconducting transition temperature T_c is depressed more rapidly with decreasing T_c than predicted by the theory of Abrikosov and Gor'kov. At low temperatures, the specific heat in the superconducting state exhibits a $\gamma_S T$ term, and γ_S/γ_N is linear in Ce concentration above ~0.1 at.% Ce substitution in La. (auth)

6398 SUPERCONDUCTIVE TUNNELLING AND APPLICATIONS. Solymar, L. New York; John Wiley and Sons, Inc. (1972). 416p. $22.95.

A review is presented of all aspects of superconductive tunneling with the exception of microscopic theory. After a brief introduction to the toxic, normal electron tunneling and Josephson tunneling are considered in turn. Diagnostic applications and weak links are described. Additional material which arrived after proofs is included in a separate chapter. Author and subject indexes are included. 964 references. (D.L.C.)

6399 STRAIN DELAY TIME AT THE SUPERCONDUCTING TRANSITION. Natsik, V. D. (Physical-Technical Inst. of Low Temperatures, Kharkov). Phys. Status Solidi (a); 14: No. 1, 271-5(16 Nov 1972).

In the creep process, a metal transition to the superconducting state is accompanied by a sharp increase in the strain rate. This increase however does not start simultaneously with the transition but in some time (relaxation time or delay time). Experiments proved this time to be strongly dependent on the temperature of the superconductor and other experimental parameters. A detailed theoretical analysis is given of the delay time in the limits of the theory of metal softening at superconducting transition, earlier suggested by the author. It is shown that the experimentally measured delay time (value and character of dependence on experimental parameters) is close to the mean time of fluctuation dislocation surmounting local barriers. The interaction with the latter determines the kinetics of the creep process. (auth)

6400 SUPERCONDUCTIVITY OF THE COMPOUNDS $Nb_3Al_xGe_{1-x}$. Dekhtyar, I. Ya.; Latysheva, V. I.; Mikhalenkov, V. S.; (and others) (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 33: No. 3, 656-8(May 1972). (In Russian).

The critical transition temperature T_c was measured for the compounds Nb_3Al and $Nb_3Al_xGe_{1-x}$ as a function of composition. Positron annihilation and the longitudinal velocity of sound in this series of samples were also investigated. Data were analyzed by the formula of W. L. McMillan (1968). The sound velocities were bracketed by the limits (m/sec) 5,270 for Nb and 5,631 for $Nb_3Al_{0.7}Ge_{0.3}$. (K.S.W.)

6401 FLUXON CONTRAST CALCULATIONS. Capiluppi, C.; Pozzi, G.; Valdre, U. (Univ., Bologna). pp 544-5 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From 5th European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

Reference is made to calculations of out-of-focus image contrast produced by fluxons (superconducting quantised flux lines) by Guigay and Bourret (CR Acad. Sci. Paris, 264: 1389(1967)) and Wohlleben (J. Appl. Phys., 38: 3341(1967)) for a single fluxon lying in a plane normal to an electron beam. These calculations assumed that a quantum of flux is associated with the fluxon, which is equivalent to considering fluxons in a specimen of infinite thickness, and the results showed that the defocus fringes should be detectable. As, however, superconductors that can be used, practically, in transmission electron microscopy work have a superconducting penetration depth λ_L of the same order as the specimen thickness, a detrimental effect on contrast for thin specimens can be expected. In this connection it was considered interesting to discuss whether it is still theoretically possible to observe fluxons, and also whether the direct observation of fluxons is within the capability of present techniques. Other effects that may contribute to reduction of the contrast are also discussed; these include the finite illumination aperture and inelastic scattering. (UK)

Equipment and Devices

Refer also to abstracts 5781, 5922, and 6837.

6402 OBSERVATION OF COHERENT MICROWAVE RADIATION EMITTED BY COUPLED JOSEPHSON JUNCTIONS. Finnegan, T. F.; Wahlsten, S. (National Bureau of Standards, Washington, DC). Appl. Phys. Lett.; 21: No. 11, 541-4(1 Dec 1972).

Here, the results are reported of a preliminary study of coherent microwave radiation emitted by a small array of interacting Josephson tunnel junctions, including the first direct observation of the superradiant state in pairs of junctions. (auth)

6403 OBSERVATION OF SUPERCONDUCTIVITY IN AN INDIUM–SILICON BISTABLE DEVICE. Broom, R. F. (IBM Zurich Research Lab., Rueschlikon, Switzerland). Appl. Phys. Lett.; 21: No. 11, 551-3(1 Dec 1972).

Superconducting behavior characteristic of a weak link is found to occur in the low-resistance state of a bistable nonvolatile switching device, formed by two closely spaced In contacts on Si. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 6226, 6775, 6781, and 6783.

6404 (CONF-721027-2) DOT-III MULTIGROUP TWO-DIMENSIONAL DISCRETE ORDINATES CODE WITH ANISOTROPIC SCATTERING. Engle, W. W. Jr.; Gritzner, M. L.; Mynatt, F. R.; Rhoades, W. A.; Rogers, R. J. (Oak Ridge National Lab., Tenn.). [nd]. 15p. Dep. NTIS.

From Seminar-workshop on shielding programmers; Ispra, Italy (16 Oct 1972).

The DOT-III computer program solves the energy and angular dependent Boltzmann equation with general anisotropic scattering for rectangular, polar, or cylindrical geometries. Principal applications are to neutron and/or gamma-ray transport problems in either forward or adjoint mode. Both homogeneous and external source problems can be solved and searches on multiplication factor, time absorption, nuclide concentration, and zone thickness are available. However, the code is particularly designed and suited to the solution of deep penetration radiation transport problems. (auth)

6405 (LA-5043) COUPLED NEUTRON-GAMMA RAY MULTIGROUP CROSS SECTIONS FOR NITROGEN, OXYGEN, SILICON, ALUMINUM, CARBON, IRON, AND HYDROGEN. LaBauve, R. J.; Seamon, R. E.; Whittemore, N. L. (Los Alamos Scientific Lab., N. Mex.). Oct 1972. Contract W-7405-eng-36. 34p. Dep. NTIS.

Coupled 30-neutron by 12-gamma multigroup cross sections for several materials in four tables, namely, P_0, P_1, P_2, and P_3 Legendre components, were produced from ENDF/B, Version III data. The nuclides processed include ^{14}N(ENDF/B MAT = 1133), ^{16}O(ENDF/B MAT = 1134), Si(ENDF/B MAT = 1151), ^{27}Al(ENDF/B MAT = 1135), ^{12}C(ENDF/B MAT = 1165), Fe(ENDF/B MAT = 1122), and ^{1}H(ENDF/B MAT = 1148). (auth)

6406 ALBEDO AND MILNE'S PROBLEMS FOR THERMAL NEUTRONS. II. Pahor, S. (Univ. of Michigan, Ann Arbor); Larson, H. A. Nucl. Sci. Eng.; 48: No. 4, 420-32(Aug 1972).

The non-uniqueness of solutions of the nonlinear integral equations for the generalized Chandrasekhar's S function and H matrix for a homogeneous half-space is discussed, and a new uniquely soluble equation for the H matrix is constructed. Then the complete solutions for the half-space albedo and Milne problems for thermal neutrons with the isotropic scattering degenerate kernel are derived. The solutions are expanded in terms of the infinite medium eigenfunctions and the expansion coefficients are determined from the corresponding emergent distributions, which have been discussed in an earlier paper and expressed in terms of the H matrix. In solving the albedo problem, the half-range completeness of the eigenfunctions is demonstrated and the corresponding half-range closure relation is derived. At the end, numerical results for the heavy gas scattering model are presented. (auth)

6407 INCOHERENT NEUTRON SCATTERING FROM HYDROGEN BOND IN KDP AND ADP. Antonini, M.; Sosnowska, I.; Vadacchino, M. (Comitato Nazionale per l'Energie Nucleare, Ispra, Italy). J. Phys. (Paris), Colloq.; No. 2, 83-4(1972).

Neutron interference effects already observed by Stiller and Grimm et al., were investigated for KH_2PO_4 (KDP) and $NH_4H_2PO_4$ (ADP) in the paraelectric phase. The measurements were made with a triple-axis spectrometer using 84-MeV neutrons. The maximum value observed for the scattering vector k was 12 A^{-1}. In the geometry used, single KDP crystals present a k vector, which rotates in the plane defined by the b + a and c vectors. Preliminary experimental evidence for the existence of a similar interference effect with ADP crystals is discussed. (France)

6408 NEUTRON INELASTIC SCATTERING AT STRUCTURAL PHASE TRANSITIONS. Cowley, R. A. (Univ. of Edinburgh). J. Phys. (Paris), Colloq.; No. 2, 7-10(1972).

Neutron inelastic scattering measurements in materials having structural phase transitions are reviewed. In some materials ($SrTiO_3$ and $KTaO_3$), a well-defined normal mode is observed whose frequency squared decreases almost linearly with temperature. In other materials appreciable damping is observed; in $BaTiO_3$ and $KNbO_3$, this damping is sufficiently large to render the scattering from these modes entirely quasi-elastic. Quasi-elastic scattering is also observed in order–disorder ferroelectrics such as $NaNO_2$ but in this case a well-defined, almost temperature-independent, phonon mode is also observed. The hydrogen-bonded ferroelectric DKDP also gives rise to quasi-elastic scattering, but in this case its origin is less clearly understood. Recent developments concerning the anisotropy of the dispersion curves, critical effects, and the determination of eigenvectors are briefly discussed. (France)

6409 STATE PRIMARY STANDARD OF THE UNIT OF THERMAL NEUTRON FLUX DENSITY. Yapitsyna, I. A.; Andreev, O. L. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 3, 352-4(Mar 1972).

Translated from Izmer. Tekh.; 15: No. 3, 7-8(Mar 1972).

A standardized neutron source was constructed to establish and maintain a unit of thermal neutron flux density. The source consists of a plastic cube inside of which is a graphite moderator with a cavity at the center. Six Pu–Be(α,n) sources are arranged symmetrically on the faces of the cube. Foil activation detectors were used to detect the neutrons. A thermal neutron flux density of 6890 n/sec · cm^2 was obtained. (J.W.R.)

6410 EFFECT OF NUCLEAR MASS ON NEUTRON TRANSFER. Zima, T. E.; Kostritsa, A. A.; Neimotin, E. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 31-7(1971). (In Russian).

The migration of neutrons in a medium of light nuclei, in particular in a moving medium, was considered on the basis of expressions for moments found for neutron distribution functions which satisfied a kinetic equation. (tr-auth)

6411 USE OF COMPUTER TECHNIQUES IN THE PUBLICATION OF NEUTRON CROSS-SECTION DATA. Garber, D. I.; Mughabghab, S. F. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 2, 797-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6412 NEUTRON PULSES IN NONCRYSTALLINE MODERATORS. Gorson, J. D. (TRW Systems Group, Redondo Beach, Calif.); Erdmann, R. C. Trans. Amer. Nucl. Soc.; 15: No. 2, 902-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6413 EFFECTS OF PHOTON EMISSION ANISOTROPY ON TRANSPORT CALCULATIONS. Dudziak, D. J.; Bosler, G. E. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 958-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6414 SENSITIVITY ANALYSIS OF NEUTRON AND GAMMA TRANSPORT IN AIR. Bartine, D. E.; Mynatt, F. R.; Oblow, E. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 959-60(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6415 INTEGRAL EXPERIMENT TO TEST GAMMA-RAY-PRODUCTION AND NEUTRON-SCATTERING CROSS SECTIONS. Harris, L. Jr.; Trimble, G. D.; Young, J. C. (Gulf Radiation Tech., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 960-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6416 MEDIUM- AND LOW-ENERGY NEUTRON CROSS-SECTION LIBRARY. Harris, D. R.; Fluharty, R. G.; Koelling, J. J.; Whittemore, N. L. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 962-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6417 WALL RETURN NEUTRON FLUXES FOR HIGH- AND INTERMEDIATE-ENERGY CAVITY NEUTRON SOURCES. Fabry, A. (National Bureau of Standards, Washington, D. C.); Jenkins, J. D. Trans. Amer. Nucl. Soc.; 15: No. 2, 975-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6418 NEUTRON FLUX ANGULAR DISTRIBUTIONS IN CARBON: A MOMENTS METHOD SOLUTION. Simmons, G. L. (Babcock and Wilcox, Lynchburg, Va.); Eisenhauer, C. Trans. Amer. Nucl. Soc.; 15: No. 2, 976(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6419 STUNFO, A STOCHASTIC NEUTRON SPECTRUM UNFOLDING CODE. Mutone, G. A.; Meyer, W. (Kansas State Univ., Manhattan). Trans. Amer. Nucl. Soc.; 15: No. 2, 982-3 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstract 6464.

6420 ^{3}He(τ,α)2p REACTION AT 9.11, 7.88, AND 6.9 MeV. de Slobodrian, M. L. V. L.; Cujec, B.; Roy, R.; Slobodrian, R. J. (Univ., Laval, Quebec). Nucl. Phys.; A194: No. 3, 577-88(1972).

The differential spectra $d^2\sigma/dEd\Omega$ of protons and α-particles have been measured for the reaction ^{3}He(He-3, α)2p at beam energies of 6.9, 7.88 and 9.11 MeV, between 11° and 54° in the laboratory, over an extended energy interval. The angular distributions corresponding to the regions of p-p and p-^{4}He enhancements indicate that the reaction proceeds mainly through two different mechanisms: direct for the p-p enhancement and compound nucleus for the p-α enhancement. The α-spectra have been analyzed in the context of the theory of final-state interactions taking into account not only the p-p interaction considered by previous authors, but also, for the first time, the p-α interaction. The agreement between the experimental and calculated curves is good, but at some angles there is a difference beyond the statistical fluctuations, that may be related to rescattering, to the presence of interference effects, to the $3/2^+$ state of ^{5}Li at 16.64 MeV, and to three-body effects in this reaction. (auth)

6421 n-d INITIAL-STATE INTERACTION IN n-d BREAK-UP. Cahill, R. T.; Sloan, I. H. (Univ. of New South Wales, Kensington, Australia). Nucl. Phys.; A194: No. 3, 589-98(1972).

The n-d initial-state interaction is shown to be an important process in the break-up reaction n + d → n + n + p. Two approximate break-up models are considered: one, without the n-d initial-state interaction, is obtained by iterating the Faddeev equations, giving the ordinary truncated multiple-scattering series; the second model is also based on the Faddeev equations, but with the initial-state interaction mechanism, which occurs only implicitly in the Faddeev equations, correctly retained. Numerical calculations are done using the n-d separable-potential model, in order that the two approximate models may be compared with exact solutions. The results show that the correct inclusion of the initial-state interaction improves the results very much. (auth)

6422 QUASIFREE PROTON–PROTON AND PROTON–DEUTERON SCATTERING ON ^{3}He. Lehman, D. R. (National Bureau of Standards, Washington, DC). Phys. Rev., C; 6: No. 6, 2023-31(Dec 1972).

Quasi-free proton scattering from ^{3}He is examined on the basis of available data. Cross sections are given in the pole-dominance approximation for either two protons or a proton and deuteron detected in coincidence. The cross sections are evaluated for a constant ^{3}He vertex and a separable-potential model of the ^{3}He vertex amplitude. Both two- and three-body breakup of ^{3}He are considered, with final-state rescattering included between the spectator nucleons in three-body breakup. It is shown that the asymptotic form of the coordinate-space ^{3}He wave function governs the shape of these low-momentum-transfer cross sections and that final-state rescattering between the spectator pair in ^{3}He (p,2p)pn mainly affects the magnitude of this cross section. (auth)

6423 OFF-SHELL EFFECTS IN THE THREE-NUCLEON SYSTEM. Bahethi, O. P.; Fuda, M. G. (State Univ. of New York, Buffalo). Phys. Rev., C; 6: No. 6, 1956-63(Dec 1972).

Results of calculations on the three-nucleon system are presented for two potentials: a spin-dependent square-well potential acting in s waves and a spin-dependent rank-one separable potential, which gives exactly the same s-wave phase shifts and deuteron binding energy as the square well. Significant differences between the T matrices arising from these potentials occur as soon as one goes off the energy shell by 40 or 50 MeV (c.m.). In the three-nucleon system the square well produces a triton binding energy of 9.11 MeV, a doublet scattering length of 0.414 fm, and quartet scattering length of 6.31 fm. The corresponding parameters for the separable potential are 9.92 MeV, −0.165 fm, and 6.33 fm. The results of calculations on the doublet and quartet s-wave elastic scattering amplitudes are presented for neutron lab energies up to 14.1 MeV. It is found that the doublet amplitudes are quite sensitive to off-shell effects, while the quartet amplitudes are not. A previously developed off-shell effective range theory for the half-off-shell T matrix is extended to the fully off-shell case. (auth)

6424 DOUBLY RADIATIVE np CAPTURE. Adler, R. J. (American Univ., Washington, DC). Phys. Rev., C; 6: No. 6, 1964-76(Dec 1972).

The cross section for n + p → d + 2γ was calculated. This process depends critically on the same matrix element that gives the amplitude for singly radiative np capture from the continuum ^{3}S state. It has been suggested that "anomalous" transitions from this continuum ^{3}S state may explain a long-standing discrepancy in np capture (σ_{exp} = 334.2 ± 0.5 mb and σ_{th} = 309.5 ± 5 mb) by contributing roughly 8% to the total np capture cross section. If this speculation is correct, then the branching ratio of doubly to singly radiative np capture is 1.4×10^{-4}. On the other hand, a conventional estimate of this amplitude yields a branching ratio of about 3.4×10^{-10}. An experimental measurement of the doubly radiative cross section in the 10-μb region should therefore settle the question of the importance of the ^{3}S initial state in the total radiative np capture cross section. Such a measurement seems at present to be much easier than similarly motivated polarization measurements. (auth)

6425 FLUX DENSITY MEASUREMENTS FOR 250 keV NEUTRONS FROM THE T(p,n) SOURCE REACTION. Paulsen, A. (Joint Nuclear Research Center, Geel, Belgium); Liskien, H.; Cosack, M. Nucl. Instrum. Methods; 105: No. 1, 103-7(1972).

Associated ^{3}He-particle counting from the T(p,n) source reaction is discussed. Two different discrimination methods were applied to separate the ^{3}He particles: from the huge number of elastically scattered protons by means of an electrostatic deflection field, and from spurious protons with degraded energy by time-of-flight discrimination. In this way the measurements could be carried out for an energy of the associated neutrons of 250 keV. The flux density of the associated neutrons was simultaneously measured by means of a proton recoil proportional counter with pulse shape discrimination against gammas. Agreement within the estimated uncertainties was found between the two measuring techniques. (6 figures) (auth)

6426 COINCIDENCE STUDY AND DWBA ANALYSIS OF THE ^{3}He + d → d + d + p REACTION. Warner, R. E. (Oberlin Coll., Ohio); Flierl, G. R.; Davies, W. G.; (and others). Nucl. Phys., A192: No. 2, 341-52(1972).

Absolute cross sections for coincidence detection of d + d, and of d + p, from the reaction ^{3}He + d → d + d + p initiated by 26.8 MeV helions, were measured at geometries in which two of the outgoing particles emerged with small relative velocity and therefore exhibited a strong final-state interaction. Good DWBA fits to most of the observed spectra were obtained using either one or two distorted waves to describe the relative motions in the final state. Woods–Saxon optical parameters for the p-d interaction are given. No enhancement resulting from sequential decays of unbound ^{3}He levels was observed. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 6070, 6461, 6464, 6467, 6534, 6585, 6590, and 6604.

6427 (GULF-RT-A-12210) MEASUREMENTS OF THE ^{10}B(n,$\alpha_1\gamma$) AND ^{10}B(n,α) CROSS SECTIONS. Final Report. Friesenhahn, S. J.; Carlson, A. D.; Orphan, V. J.; Fricke, M. P. (Gulf Radiation Technology, San Diego, Calif.). 16 Oct 1972. Contract AT(04-3)-167. 135p. Dep. NTIS.

Measurements of the ^{10}B(n,α) and ^{10}B(n,$\alpha_1\gamma$) cross sections relative to the hydrogen scattering cross section are reported. The ^{10}B(n,α) cross section was determined from 4- to 750-keV neutron energy, with an overall systematic uncertainty of ~2 to 3% over most of the energy region. The ^{10}B(n,$\alpha_1\gamma$) cross section was determined from 4 to 1000 keV with an over-all systematic uncertainty of ~1 to 2% at most energies. Using fine neutron energy groups of $\Delta E/E$ = 5%, the total statistical uncertainties in both cross sections are ~2 to 3% at all energies. (L.T.W.)

6428 DEUTERON STRIPPING TO THE SINGLE PARTICLE STATES OF ^{17}O. Cooper, Martin David. College Park, Md.; Univ. of Maryland (1972). 150p. University Microfilms Order No. 72-20,786.

Thesis.

Angular distributions for the ^{16}O(d,p)^{17}O and ^{16}O(d,d)^{16}O reactions have been measured at bombarding energies of 25.4, 36 and

63.2 MeV on the University of Maryland variable energy cyclotron. A gas target was used in the experiment to get absolute cross sections accurate to better than 10%. The elastic deuteron data has been fit with a standard spin one optical model potential to obtain parameters for use in a DWBA analysis of the (d,p) data. The potential found in the search is shown to be consistent with other data taken in the range from 25 to 82 MeV. The emphasis of the (d,p) data is on stripping to the single particle states of ^{17}O. The ground state and first excited state, identified as $1d_{\frac{5}{2}}$ and $2s_{\frac{1}{2}}$ with respect to an ^{16}O core, are bound and are analyzed by standard DWBA techniques. The ^{17}O-proton elastic potential is extrapolated from fits to ^{16}O-proton elastic scattering data. The 5.08-MeV state, identified as $1d_{\frac{3}{2}}$, is unbound and analyzed with a DWBA program which does the integral of the oscillating tail in the complex plane. In addition to the elastic scattering deuteron optical potential, an adiabatic deuteron potential was used which includes the effects of deuteron breakup. The spectroscopic factors found for the ground and first excited states are between 0.8 and 1.0 and are consistent with the single particle picture and lower energy data. The width extracted from the DWBA analysis of the 5.08-MeV state was 20% less than for elastic neutron scattering to the same state, possibly pointing up some difficulties with DWBA procedures commonly used. R-matrix theory is used to extract a spectroscopic factor from the ^{16}O(n,n)^{16}O data near the 5.08-MeV state, and a value of 0.8 is obtained. The spectroscopic factors deduced from DWBA analysis and R-matrix theory are sensitive to the mean square radius of the potential generating the optical wave functions of the states, and a prescription is given for finding the mean square radius from electron scattering data. When the conventional deuteron potential is used in the DWBA calculations, the spectroscopic factors appear energy independent. The use of the adiabatic potential seems to produce a mild trend for the spectroscopic factor to increase with energy. However, the adiabatic potential does generate considerably improved shapes in the calculated angular distributions. (Diss. Abstr. Int., B)

6429 POLARIZATION OF PROTONS FROM THE ^{9}Be(d,p)^{10}Be REACTION AT E_d = 12.0 MeV. Budzanowski, A.; Freindl, L.; Karcz, W.; (and others). (Inst. of Nuclear Physics, Krakow). Nucl. Phys.; A195: No. 1, 280-8(1972).

The polarization of protons from the ^{9}Be(d,p)^{10}Be reaction at E_d = 12.0 MeV was measured for the ground state and first excited state transitions. The results obtained are compared with the predictions of DWBA theory. It was found that better fits to the experimental data can be obtained using volume absorption in the distorting potential of the deuteron elastic channel. A comparison of the present polarization data with the vector analyzing power for the same reaction and the same incident deuteron energy has also been made. (auth)

6430 SEARCH FOR AN 8^+ LEVEL IN ^{16}O WITH THE ^{12}C(α,^{8}Be)^{8}Be REACTION. Martin, Ph.; Ophel, T. R. (Australian National Univ., Canberra). Nucl. Phys.; A194: No. 3, 491-6 (1972).

The ^{12}C(α,^{8}Be(g.s.))^{8}Be(g.s.) reaction has been re-examined between E_α = 15.0 and 18.96 MeV. Excitation functions were measured at $90°_{c.m.}$ and at lab angles of 20° and 30°, and angular distributions were obtained at E_α = 17.4, 17.7, 18.05 and 18.36 MeV. No evidence was found for an 8^+ level at an excitation energy near 20.8 MeV. Analysis of the angular distributions demonstrated that the highest contributing l-value in the 20–21 MeV energy region is l = 6. (auth)

6431 SEARCH FOR A POSSIBLE $J^\pi = 0^+$, T = 2 RESONANCE IN ^{9}Be(τ,$\gamma\gamma$)^{12}C. Hanna, S. S. (Weizmann Inst. of Science, Rehovot, Israel); Hass, M.; Shkedi, Z.; Horowitz, Y. S. Nucl. Phys.; A195: No. 1, 91-6(1972).

A 50 cm^3 Ge(Li) detector has been used to re-examine the reaction ^{9}Be(τ,$\gamma\gamma$)^{12}C over a previously reported resonance at $E(\tau)$ = 1.739 ± 0.007 MeV which was suggested as the lowest T = 2 state in ^{12}C. This state is expected to γ-decay via the 1^+, T = 1 state at 15.11 MeV. However a search with τ bombarding energies ranging two standard deviations above and below the reported resonance energy revealed no resonance in high-energy γ-rays. An upper limit of $\Gamma_\tau\Gamma_\gamma/\Gamma < 2.0$ MeV is established for the T = 2 resonance strength which is one-fourth of the previously reported strength and which strongly corroborates an additional negative result reported as $\Gamma_\tau\Gamma_\gamma/\Gamma <$ 1.5 MeV. In the course of the experiment a new value of Γ_{lab} = 2.94 ± 0.20 keV was obtained for the resonance at E_p = 1.083 MeV in ^{9}Be(p,γ)^{10}B. (auth)

6432 EFFECT OF 3^- SPIN AND PARITY ON THE ENERGY DISTRIBUTION IN THE FINAL STATE OF THE REACTION ^{11}B(p,3α). Chanut, Y.; Scheurer, J. N.; Ballini, R.; (and others) (Institut d'Etudes Nucleaires, Algiers). Nucl. Phys.; A194: No. 3, 523-34(1972).

A complete kinematic study of ^{11}B(p,3α) has been done around E_p = 2.65 MeV as a bombarding energy, corresponding to the 18.36 MeV resonance in ^{12}C. The hole in the Dalitz plot near the zero energy of the third particle is explained by assigning 3^- to this ^{12}C state. (auth)

6433 DETERMINATION OF HALF-LIFE OF ^{14}O AND VALUE OF BETA-DECAY COUPLING CONSTANT G_V. Singh, J. (Panjab Univ., Chandigarh, India). Indian J. Pure Appl. Phys.; 10: No. 4, 289-92(Apr 1972).

With a view to estimating the correct value of the polar vector beta decay coupling constant (G_V), the half-life of the positron emitting Fermi super-allowed transition ^{14}O(β^+)^{14}N has been redetermined under various conditions. An average half-life of 70.32 ± 0.12 sec has been obtained. This implies a partial half-life of 70.74 ± 0.13 sec for the transition to the 2.31 MeV state of ^{14}N. Using this half-life value and the recent value of f reported by J. M. Freeman and W. E. Burcham [Physics Lett., 27B (1968), 156], Gf has been evaluated to be (1.4302 ± 0.0041) × 10^{-49} erg cm^3. Taking G_μ to be (1.4350 ± 0.003) × 10^{-49} erg cm^3 as reported by S. M. Berman [Phys. Rev., 112 (1958), 267], the ratio $(G_\mu - G_V)/G_\mu$ has been estimated to be (0.3 ± 0.2)%. (auth)

6434 RADIOCHEMICAL MEASUREMENTS OF ^{10}Be AND ^{7}Be FORMATION CROSS SECTIONS IN OXYGEN BY 135 AND 550 MeV PROTONS. Amin, B. S.; Biswas, S.; Lal, D.; Somayajulu, B. L. K. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys.; A195: No. 1, 311-20(1972).

Radiochemical measurements of the activities of ^{10}Be and ^{7}Be in oxygen due to the bombardment of water samples by protons of energies 135 and 550 MeV are reported. The ratios $\sigma(^{10}\text{Be})/\sigma(^{7}\text{Be})$ of the cross sections in oxygen are found to be 0.19 ± 0.01 and 0.32 ± 0.02 for 135 and 550 MeV protons, respectively, based on $t_{\frac{1}{2}}(^{10}\text{Be})$ = 2.7 × 10^6 y and $t_{\frac{1}{2}}(^{7}\text{Be})$ = 53.6d. Using the best estimate of the excitation function of ^{7}Be in oxygen, the formation cross sections for ^{10}Be in oxygen are estimated to be 1.0 ± 0.06 and 2.9 ± 0.2 mb for protons of energies 135 and 550 MeV respectively. Cross sections for ^{10}Be in oxygen, averaged over the energy spectrum of cosmic rays, and based on the observations of its activity in meteorites and deepsea sediments are discussed. The implication of the present measurements for the use of the ^{10}Be isotope as a "clock" to estimate the "age" of cosmic rays is briefly noted. (auth)

6435 PION ABSORPTION AND THE STRUCTURE OF ^{6}Li. Jain, B. K. (Bhabha Atomic Research Centre, Bombay). Nucl. Phys.; A194: No. 3, 651-56(1972).

The available data on the ^{6}Li(π^-,nn) reaction are analyzed using the two-nucleon model for pion absorption, distorted waves for the outgoing neutrons, a Seki–Cromer wave function for the 1S pion and the modified α–d cluster-model wave function of Jain et al. for ^{6}Li. The computed results are not in good agreement with the experimental data. Possible ways of improvement are pointed out. The sensitivity of the recoil momentum distribution to the radial inter-cluster wave function is studied. (auth)

6436 TRANSITION STRENGTHS OF ANALOGUE STATES IN A = 18 NUCLEI. Rolfs, C. (Univ. of Toronto). Can. J. Phys.; 50: No. 16, 1791-4(15 Aug 1972).

A search for the 3061(2^+, T = 1) → 1041(0^+, T = 1) keV γ-ray branch in ^{18}F was performed with the use of the capture reactions ^{14}N(α,γ)^{18}F at E_α = 1526 keV and ^{17}O(p,γ)^{18}F at E_p = 741 keV. The observed branching ratio is 0.11 ± 0.03%. The mean life of the 3061 keV state was found to be < 1.5 fs. This E2 branch in ^{18}F is compared with the analog transitions in ^{18}O and ^{18}Ne as well as with shell model calculations. (auth) (Canada)

6437 PHOTONEUTRON CROSS SECTIONS IN ^{14}N. Gellie, R. W. (National Research Council of Canada, Ottawa); Lokan, K. H.; Sherman, N. K.; Johnson, R. G.; Lodge, J. I. Can. J. Phys.; 50: No. 15, 1689-96(1 Aug 1972).

Photoneutron distributions from ^{14}N were obtained by time-of-flight methods, for bremsstrahlung end-point energies increasing in 2 MeV steps from 15.5 to 29.5 MeV. A large part of the neutron yield is associated with the sequential decay of ^{14}N to ^{12}C, through well-defined intermediate states of ^{13}C, at 7.55, 8.86, and 11.80 MeV, which are unstable against neutron emission. The (γ,n_0) cross section for neutron emission to the ground state of ^{13}N is found to agree very closely with the corresponding (γ,p_0) cross section, implying a high degree of isospin purity for the giant dipole resonance of ^{14}N. It is observed that the decay of the giant resonance proceeds freely through those odd-parity excited states of the A = 13 nuclei which are single hole states formed by the removal of a p-shell nucleon from the parent ^{14}N. The integrated cross section for all neutron-producing interactions is found to be 88 ± 5 MeV mb. (auth) (Canada)

6438 ENERGY AND ANGLE DISTRIBUTIONS OF NEUTRONS EMITTED IN THE INTERACTIONS OF 3 GeV PROTONS WITH CARBON, ALUMINUM, AND COBALT. Nalesnik, W. J. Philadelphia; Univ. of Pennsylvania (1972). 135p. University Microfilms Order No. 72-25,638.

Thesis.

The energy and angle distributions of high energy neutrons emitted in spallation reactions induced by 3-GeV protons on thin targets of carbon, aluminum, and cobalt were measured using time-of-flight techniques. The targets were chosen on the basis of astrophysical, geophysical, and radiological interest. The experiment was performed at the 3-GeV Princeton-Pennsylvania Accelerator using internal targeting and the 20, 34, and 90° beam lines. The neutron energies covered were from 10 to 900 MeV. Relative differential cross sections were obtained with an experimental accuracy of 10 percent. The experimental results can be interpreted in terms of the two-step cascade-and-evaporation model of high energy nuclear reactions. The neutron spectra exhibit a sharp inflection between 20 and 30 MeV which can be interpreted as the demarcation between the region in which evaporation neutrons dominate and the region in which knock-on neutrons dominate. The knock-on region above ~100 MeV at both 20 and 90° can be approximated by a power law of the type E^{-n}, where n increases with atomic weight. The integrated differential cross sections, $d\sigma(\theta)/d\Omega$, exhibit an $A^{0.7}$ dependence over the measured energy range. The experimental work was compared with the theoretical calculations of Bertini; the results are in good agreement at 90°. At 20° the experimental yields are slightly larger in the knock-on region above 120 MeV; however, this discrepancy decreases with increasing atomic weight. (Diss. Abstr. Int., B)

6439 MECHANISMS OF THE PHOTONUCLEAR GIANT RESONANCE OF ^{14}N. Bentz, Edward J. Jr. New Haven; Yale Univ. (1971). 239p. University Microfilms Order No. 72-20,075.

Thesis.

The ground ($\frac{1}{2}^-$ ^{13}C) and excited state ($\frac{3}{2}^-$ ^{13}C, 3.68 MeV) photoproton spectra from the ^{14}N giant resonance have been obtained using Si(Li) detectors at six angles simultaneously. Angular distributions and absolute cross sections, at 100 KeV intervals between 14.6 and 25.0 MeV, have been derived for the photoproton reactions proceeding to the ground and ($\frac{3}{2}^-$) excited residual states. Branching ratios between photoproton reactions proceeding to the ground and ($\frac{3}{2}^-$) excited residual states have been obtained, and integrated strengths for both photoproton reactions have been computed. Legendre coefficients for both photoproton cross sections have been presented as a function of energy, with their respective uncertainties. Complementary ^{14}N(γ,p,$^{n}_{\alpha}$,γ'), ^{16}O(γ,$^{n}_{p}$,γ') angular distribution measurements, using high resolution 40 cc Ge(Li) detectors, have been performed through the ^{14}N giant resonance energy region. These complementary measurements have permitted identification of the subsequent excited residual states in ^{13}C following direct ^{14}N* photoproton emission. Absolute D(γ,p) cross sections and angular distributions have been measured from 12.5 to 25 MeV, photon energy, using an identical photoproton experimental setup, to provide absolute proton detector efficiencies to within 5%. Features of the ^{14}N giant resonance and possible configuration assignments are discussed for this first such excited state (γ,p_x) angular distribution measurement. (Diss. Abstr. Int., B)

6440 STUDY OF ^{15}N STATES BY THE ^{14}N(d,p) REACTION. Amokrane, A. (Institut d'Etudes Nucleaires d'Alger, Algiers); Allab, M.; Beaumevieille, H.; (and others). Phys. Rev., C; 6: No. 6, 1934-45(Dec 1972).

The bound states of ^{15}N were studied by the ^{14}N(d,p) reaction. Absolute differential cross sections were measured at E_d = 3 MeV for the 9.05-, (9.152 + 9.155)-, 9.22-, 9.76-, and 10.07-MeV states and at E_d = 3.6 MeV for the 9.76-, 9.83-, 9.93-, 10.07-, and 10.45-MeV states in ^{15}N. The target was natural nitrogen confined in a differentially pumped gas target. Distorted-wave Born-approximation analysis and Hauser–Feshbach calculations indicate that $l_n = 1$ is involved in the formation of the 9.22-, 9.76-, and probably 10.45-MeV states, whereas $l_n = 2$ transfer is associated with the 9.155-MeV level. An $l_n = 0$ transfer was discerned for the angular distribution associated with the 9.05-MeV state and $l_n = 0 + 2$ for the angular distribution associated with the 10.07-MeV and probably the 9.93-MeV ^{15}N state. Spectroscopic factors were obtained. The correspondence between mirror levels in ^{15}N and ^{15}O and those predicted within the framework of the weak-coupling model is discussed. (auth)

6441 HALF-LIVES OF ^{17}N AND ^{17}F. Alburger, D. E. (Brookhaven National Lab., Upton, NY); Wilkinson, D. H. Phys. Rev., C; 6: No. 6, 2019-22(Dec 1972).

The radioactivities ^{17}N and ^{17}F were produced in the reactions ^{15}N(t,p)^{17}N and ^{16}O(d,n)^{17}F, and their half-lives were measured by observing the decay of neutrons from ^{17}N and 0.51-MeV γ rays from ^{17}F. The half-life obtained for ^{17}N is 4.169 ± 0.008 s, in agreement with earlier measurements. The value for ^{17}F, $T_{\frac{1}{2}}$ = 64.50 ± 0.25 s, is considerably lower than previous measurements. The relevance of the ^{17}N result to the question of mirror symmetry in the β decay of the A = 17 system is discussed. (auth)

6442 THREE-BODY MODEL FOR PROTON-INDUCED REACTION ON ^{12}C. Strobel, G. L. (Kernforschungsanlage, Juelich, Ger.). Phys. Rev., C; 6: No. 6, 2039-46(Dec 1972).

The (p,2p) and the (p,d) reaction cross sections for a ^{12}C target were calculated using a three-body theory that avoids making the Born approximation. Real separable potentials were used to describe all interactions. The general shape and magnitude of the reaction cross section agree with the experimental data. Fine structure details of the experimental cross sections are not reproduced. Modifications to distorted-wave Born-approximation calculations are suggested. (auth)

6443 ^{12}C(^{16}O,α)^{24}Mg EXCITATION FUNCTIONS AND STATISTICAL-MODEL CALCULATIONS FOR HIGH-SPIN STATES IN ^{24}Mg. Greenwood, L. R.; Katori, K.; Malmin, R. E.; (and others) (Argonne National Lab., Ill.). Phys. Rev., C; 6: No. 6, 2112-26(Dec 1972).

High-resolution excitation functions were measured in the energy range $E_{c.m.}$ = 19 to 25 MeV for the ^{12}C(^{16}O,α) reaction to highly excited states in ^{24}Mg($E_{exc} \approx$ 13.5 to 17.5 MeV). The strong, rapid observed fluctuations suggest a predominately compound-nucleus reaction mechanism. The selective population of high-spin states in ^{24}Mg by the present reaction, in contrast to the lack of such selectivity in the ^{14}N(^{14}N,α) reaction, can readily be explained by Hauser–Feshbach statistical-model calculations. A fluctuation analysis indicates coherence widths of 90 to 150 keV, and cross correlations were found to be small and thus compatible with a purely statistical compound-nucleus process. (auth)

6444 EFFECT OF SPIN-ORBIT INTERACTIONS ON ANGULAR CORRELATIONS IN ^{10}B(d,nγ)^{11}C. Parson, J. T. Jr. Charlottesville, Va.; Univ. of Virginia (1972). 198p. University Microfilms Order No. 72-26,280.

Thesis.

Angular correlations were performed on the ^{10}B(d,nγ)^{11}C reaction using multiparameter data analysis techniques. States at 4.31, 4.79, 6.48, 6.91, and 8.43 MeV excitation were observed. A total of 48 correlations were obtained during four runs of the ^{10}B(d,nγ)^{11}C reaction. Correlations for the 6.48 MeV to ground state and the 8.43 MeV to ground state transitions were compared to theoretical predictions of the correlation anisotropy using PWBA and DWBA stripping theory. This analysis indicated that PWBA and DWBA (spin-orbit interactions neglected) theories were adequate in describing the reaction plane anisotropies and compound nucleus effects were generally rejected by the data. Ratios of out-of-plane anisotropies in some cases do not support either PWBA or DWBA (no spin-orbit) and hence suggest the need for analysis by DWBA (spin-orbit interactions included). Following this, it is shown that the distortion parameter for DWBA theory with spin-orbit interactions included, has the values $\gamma(\theta_n) = 3.2$ for the 6.48 MeV correlations and $\gamma(\theta_n) = 0.33$ for the 8.43 MeV correlations. Theoretical predictions of this parameter are not yet available. In addition, branching ratios of 87 ± 8% and 93 ± 8% were determined for the ground state transitions of the 6.48 MeV and 8.43 MeV states respectively. (Diss. Abstr. Int., B)

6445 ISOSPIN RESONANCES IN 4N NUCLEI. Hanna, S. S. (Stanford Univ., Calif.). pp 30-74 of Fourth Symposium on the Structure of Low-Medium Mass Nuclei. /Davidson, J. P. (ed.). Lawrence, Kan.; University Press of Kansas (1972).

From fourth symposium on the structure of low-medium mass nuclei; Lawrence, KS. (12 Oct 1970). See CONF-701073.

After a general introduction, the T = 2 resonances are discussed for the 4N nuclei individually from A = 8 to A = 32; there appears to be no regularity in the partial widths of T = 2 levels in the 1p shell. Next, the T = 1 levels of nuclei in the 2s–1d shell that are involved in the cascades from the T = 2 levels are discussed, along with the use of a sum rule to consider their strengths and what that reveals about nuclear structure. Finally, brief remarks are made on the following topics: isospin mixing in ^{8}Be; isospin mixing in ^{40}Ca; isospin mixing in other T = 2 levels; shell-model description of T = 2 levels; rotational model; search for $\Delta T = 2$ gamma transitions; and analog beta and gamma transitions. (24 figures, 4 tables) (R.W.R.)

6446 ADVANCING COMPUTER TECHNOLOGY AND IMPLICATIONS FOR NUCLEAR PHYSICS EXPERIMENTATION.

Birnbaum, J. (IBM Thomas J. Watson Research Center, Yorktown Heights, N. Y.); Sachs, M. W.; Bromley, D. A. pp 244-64 of Fourth Symposium on the Structure of Low-Medium Mass Nuclei. /Davidson, J. P. (ed.). Lawrence, Kan.; University Press of Kansas (1972).

From fourth symposium on the structure of low-medium mass nuclei; Lawrence, KS. (12 Oct 1970). See CONF-701073.

The possible effects of the rapidly advancing computer technology upon the manner in which experiments are conducted and, perhaps, the nature of the experiments themselves are examined. The paper is not a review of the field or necessarily a description of any specific system. Some typical current uses of computers in nuclear physics are described; these include automatic control of experimental conditions, on-line compensation for physical conditions, interactive data reduction, interactive theoretical calculation, and graphical representation. Advances in the new technology with respect to memory, computing power, microprogramming, system organization, communications and networks, and interacting: hardware and software are discussed. Finally, a brief description of a prototype system is given. (5 figures) (R.W.R.)

6447 INVESTIGATION OF ^{16}O STATES BY THE $^{15}N(d,n)^{16}O$ REACTION. Fogel, R. P.; Thornton, S. T. (Univ. of Virginia, Charlottesville). Nucl. Phys., A192: No. 2, 391-404 (1972).

Using the pulsed beam, neutron time-of-flight method, polarization angular distributions for thirteen states in ^{16}O have been measured for the $^{15}N(d,\vec{n})^{16}O$ reaction at a deuteron energy of 4.83 MeV. The differential cross section for elastic scattering of deuterons from ^{15}N was analyzed using the optical-model formalism to provide initial-state wave functions for distorted-wave method calculations of the $^{15}N(d,\vec{n})^{16}O$ reactions. These calculations were compared to experimental differential cross-section and polarization data and were used for an analysis of $P(\theta)\sigma(\theta)$. The agreement between experiment and calculations is fair for most of the states. The summed particle strengths and energy centroids were calculated for several particle states and were compared to shell-model calculations. (auth)

6448 TWO-PARTICLE THREE-HOLE STRUCTURE OF NEGATIVE-PARITY STATES IN ^{15}N. Steerman, C. E.; Young, F. C. (Univ. of Maryland, College Park). Nucl. Phys., A192: No. 2, 353-71(1972).

The 2p-3h character of negative-parity states of ^{15}N was studied using the two-particle transfer $^{13}C(^3He,p)^{15}N$ reaction. Absolute differential cross sections were measured at 5 MeV bombarding energy for all excited states below 8 MeV and for the 9.05, 9.152 + 9.155 and 9.22 MeV states. According to a two-particle DWBA analysis of these angular distributions, the 9.22 MeV state is assigned negative parity. From γ-γ angular correlation measurements of the 9.22−6.32−0 MeV cascade decay, a preferred spin value of $\frac{1}{2}$ is found for this state. This is the first excited state in ^{15}N of the same J^π as the ground state. The Doppler-shift attenuation method was applied to Ge(Li) γ-ray spectra to obtain lifetimes of $\leq$100 fs for states from 7 to 10 MeV excitation in ^{15}N. Analog states in ^{15}N and ^{15}O are identified with corresponding theoretical negative-parity states for the A = 15 system. The DWBA analysis indicates that the 9.22 MeV state has the configuration $(1p)^{-3}(2s_{\frac{1}{2}})^2$ and that the 9.152 MeV state is a mixture of the configurations $(1p)^{-3}(2s_{\frac{1}{2}})^2$ and $(1p)^{-3}(1d_{\frac{3}{2}})^2$. Small but significant admixtures of 2p-3h configurations are required to account for the measured angular distributions for the ground and 6.32 MeV states. (auth)

6449 MEASUREMENT OF THE ANGULAR DISTRIBUTION OF THE α-PARTICLES FROM THE REACTION $^{11}B(p,\alpha_1)^8Be^*$ (2.9 MeV). Gemeinhardt, W.; Kamke, D. (Ruhr-Univ., Bochum, Ger.). Z. Phys.; 255: No. 2, 119-45(1972). (In German).

It is not possible to measure the angular distribution of the α-particles from $^{11}B(p,\alpha_1)^8Be^*$ (2.9 MeV) with a simple one-detector arrangement, because the background α-particle spectrum from $^8Be^*$ will change shape and contents with angle. Therefore a coincidence method is employed. Two detectors are arranged in such a way that with any angle in the laboratory system the angle between the detectors is 180° in the center of mass system. By this method angular correlations are eliminated and the angular distribution of α_1 can be measured as long as the two coincident lines, recorded by each detector, are separable. Since this is not always the case the angular distributions are determined only for reactions proceeding through the two excited states in ^{12}C that are reached with 1.39 and 2.64 MeV proton energy. Angular distributions of the α_0 radiation have been remeasured. (auth)

6450 BACKWARD SCATTERING OF 14.1 MeV NEUTRONS FROM ^{16}O. Bonazzola, G. C. (Univ., Turin); Bressani, T.; Chiavassa, E.; (and others). Lett. Nuovo Cim.; 5: No. 3, 226-30(16 Sep 1972).

Neutron spectra and angular distributions for 14.1-MeV neutron scattering from ^{16}O were measured at 150 to 180° using a time-of-flight spectrometer. The data were analyzed using a spherical optical potential. Calculations with two sets of parameters failed to predict the fall off of the cross section at backward angles. (J.W.R.)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 6438, 6445, 6482, 6484, 6534, and 6603.

6451 (BLG-465) EVALUATION OF MICROSCOPIC INTEGRAL CROSS-SECTIONS AVERAGED IN THE ^{235}U THERMAL FISSION NEUTRON SPECTRUM (FOR 29 NUCLEAR REACTIONS RELEVANT TO NEUTRON DOSIMETRY AND FAST REACTOR TECHNOLOGY). Fabry, A. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). May 1972. 28p. Dep. NTIS (U. S. Sales Only).

For a number of (n,γ), (n,f), (n,n'), (n,p), (n,α) and (n,2n) nuclear reactions of interest in technological applications, it has been attempted to assess the best experimental values and errors of the microscopic average cross-sections in the uranium-235 thermal fission neutron spectrum. This evaluation has been done in a way as independently as possible of any assumption regarding differential nuclear data, but the interrelations are indicated whenever necessary. The emphasis has been laid primarily on the relative internal consistency of the evaluated integral data rather than on the proposed absolute scale; for the considered threshold reactions, this scale is presumably the most critically weighted by the accepted $^{235}U(n,f)/^{238}U(n,f)$ integral cross-section ratio of 3.81 ± 0.15. The need for more decisive experimental clarification is suggested thoroughly. (auth)

6452 ELECTROMAGNETIC TRANSITIONS IN ^{27}Si. Rios, Miguel Jr. College Park, Md.; Univ. of Maryland (1972). 135p. University Microfilms Order No. 72-20,497.

Thesis.

Electronuclear properties of the first six excited states of ^{27}Si have been investigated using the $^{28}Si(^3He,\alpha\gamma)^{27}Si$ reaction. The branching ratios of the levels at 0.96, 2.17, 2.65, 2.87, and 2.91 MeV have been measured. A 5'' dia. × 5'' NaI crystal has been used to detect γ rays in coincidence with α particles from the level of interest. A double-focussing magnetic spectrometer was used for momentum analysis of the α particles. The decay schemes of the levels at 2.87 and 2.91 MeV were studied with a position sensitive detector at the exit of the magnet. The geometry of Method II of Litherland and Ferguson was used in $\alpha-\gamma$ angular correlation studies of the levels at 0.78, 0.96, and 2.65 MeV. An annular silicon detector was used to detect α particles in coincidence with γ rays detected in any one of four 3'' × 3'' NaI detectors. The angular correlation of the level at 0.78 MeV is consistent with a $J = \frac{1}{2}$ spin assignment. A spin assignment of $J = \frac{3}{2}$ is made for the level at 0.96 MeV and an E2/M1 mixing ratio of $\delta = -0.35$ is extracted. $J = \frac{5}{2}$ is assigned to the level at 2.65 MeV and the results for the E2/M1 mixing ratios of the predominant transitions are: $\delta = 0.065$ for the 2.65 → 0.96 MeV transition and $\delta = 0.42$ for the 2.65 → 0.0 MeV transition. Empirical wave functions for the first seven levels of ^{27}Si are derived in a phenomenological Core Excitation Model. Mixing ratios, M1 and E2 reduced transition probabilities, and branching ratios have been computed with these wave functions. In general good agreement is obtained with experiment. The strength and energy parameters of the core-particle (hole) interaction, necessary to obtain agreement with the excitation spectrum, are compared with the results of other investigations of the Core Excitation Model in $^{27}Al-^{27}Si$. (Diss. Abstr. Int., B)

6453 PROTON ENERGY AND ANGULAR DISTRIBUTIONS FROM(n,p) AND (n,np) REACTIONS. Alvar, K. R. (Brown Univ., Providence). Nucl. Phys.; A195: No. 1, 289-301(1972).

The proton energy and angular distributions from (n,p) and (n,np) reactions on ^{27}Al, ^{32}S, ^{59}Co and ^{58}Ni have been measured for 14.1 MeV neutrons. The proton detection threshold was approximately 2 MeV and the reaction angles from 0° to 120° were used in 20° increments. Thin isotopically pure targets and particle discrimination were used. The level-density parameters, nuclear temperatures and total (n,p) and (n,np) cross sections are reported. Direct contributions are estimated. (auth)

6454 INVESTIGATION OF ^{36}Ar WITH THE $^{35}Cl(p,\gamma)^{36}Ar$ REACTION. I. BRANCHING RATIOS, EXCITATION ENERGIES,

AND LIFETIMES OF ^{36}Ar LEVELS. Hokken, G. A.; Hendricx, J. A. J. G.; De Kogel, J. (Rijksuniversiteit, Utrecht). Nucl. Phys.; A194: No. 3, 481-90(1972).

The γ-ray spectra of 20 resonances in the ^{35}Cl(p,γ)^{36}Ar reaction have been measured with a Ge(Li) detector. Branching ratios and energies of the resonances and of 29 bound states have been determined. Two new doublets have been found at E_x = 7.14 and 7.25 MeV. The reaction Q-value has been determined as Q_0 = 8506.9 ± 0.3 keV; this value was used to deduce accurate proton energies of the resonances. Lifetimes of 22 bound states have been obtained from Doppler-shift attenuation measurements. (auth)

6455 PROPERTIES OF THE 612 keV RESONANCE IN THE ^{27}Al(p,γ)^{28}Si REACTION. Anyas-Weiss, N.; Litherland, A. E.; Smulders, P. J. M. (Univ. of Toronto). Can. J. Phys.; 50: No. 17, 1949-56(1 Sep 1972).

Gamma rays from the resonance at E_p = 612 keV in the ^{27}Al(p,γ)^{28}Si reaction were studied using a 40 cm^3 Ge(Li) counter. Doppler shift measurements on the primary gamma ray show (85 ± 3)% of the expected full shift, indicating a lifetime of 13 ± 3 fs for the resonance level. A good parameterless fit to the 12 angular correlation coefficients obtained by Heyligers suggests a spin of 5 for the resonance as an alternative to the previously considered values of 2, 3, and 4. A weak 2% decay from the 12 174 keV resonance level to the 3$^+$ level at 8586 keV was observed, and the E2/M1 mixing ratio for the decay from the 6276 keV, 3$^+$ level to the 4617 keV, 4$^+$ level was obtained. A Q value for the ^{27}Al(p,γ)^{28}Si reaction of 11 584.1 ± 1.5 keV was measured. (auth) (Canada)

6456 EMPIRICAL VALUES OF HIGHER-ORDER MATRIX ELEMENTS IN FIVE HINDERED-ALLOWED β-DECAYS: ^{22}Na, ^{182}Ta, ^{56}Mn, ^{58}Co, ^{32}P. Singhal, Rajendra P.; Knowles, H. P. (Washington State Univ., Pullman). Nucl. Phys.; A194: No. 3, 642-50(1972).

The available experimental data on the spectrum shape, $\beta-\gamma$ directional correlation, $\beta-\gamma$ (circularly polarized) correlation, and β-ray longitudinal polarization for the hindered-allowed β-decays of ^{22}Na, ^{182}Ta, ^{56}Mn, ^{58}Co, and ^{32}P have been utilized to deduce three higher-order matrix elements. Exact electron radial functions which take into account finite nuclear size and de Broglie wavelength effects have been used in the present analysis. The values of matrix element ratios $M(i\gamma_5 r)/M(\sigma)$, $M((\sigma\cdot r)r)/M(\sigma)$ and $-C_V M(\alpha \times r)/C_A M(\sigma)$ have been obtained. (auth)

6457 ANALYSING POWERS FOR PROTONS ELASTICALLY SCATTERED BY A THICK SILICON TARGET. Hempel, G.; Hofmann, A.; Kilian, K. (Univ., Erlangen, Ger.). Nucl. Instrum. Methods; 105: No. 1, 91-5(1972).

In order to get data for constructing proton polarimeters using silicon detectors as analyzing targets, measurements with a 33-μm natural silicon target and polarized protons were performed. It was found that the most favorable conditions for proton energies below 6 MeV can be obtained at backward angles. (auth)

6458 LIFETIME OF THE 2$^+$ 1759-keV STATE IN ^{26}Al VIA THE ^{23}Na(α,nγ)^{26}Al REACTION. Marmor, M.; McDonald, J. M.; Fossan, D. B. (State Univ. of New York, Stony Brook). Phys. Rev., C; 6: No. 6, 2109-12(Dec 1972).

Lifetimes of excited states in ^{26}Al were investigated by the recoil-distance method using the ^{23}Na(α,nγ)^{26}Al reaction. To obtain information on the population of states in ^{26}Al by this reaction, a Ge(Li) γ-ray spectrum was measured in coincidence with neutrons. A mean life τ = 5.7 ± 1.1 ps was obtained for the 2$^+$ 1759-keV state in ^{26}Al. (auth)

6459 INELASTIC EFFECTS IN THE STUDY OF ^{23}Na AND ^{23}Mg. Nelson, R. O. (Duke Univ., Durham, NC); Roberson, N. R. Phys. Rev., C; 6: No. 6, 2153-67(Dec 1972).

Fourteen states of ^{23}Na with excitation energies <5.6 MeV and their mirror states in ^{23}Mg were studied with the ^{24}Mg(d,^{3}He) ^{23}Na and ^{24}Mg(d,t)^{23}Mg reactions with a bombarding energy of 21.1 MeV. Differential cross-section measurements indicated significant differences between established l = 2 transitions and large cross sections for "j-forbidden" $^1/_2^+$ and $^5/_2^+$ states. Failure of a distorted-wave analysis to predict these anomalies suggested that inelastic effects should not be neglected. Calculations with the coupled-channel Born approximation (CCBA) produced agreement with experiment and showed that multiple-step processes not only dominate the transitions to the "j-forbidden" states, but have large effects upon allowed transitions as well. From the CCBA predictions it was possible to identify mirror states of the nuclei and to establish J$^\pi$ assignments of $^9/_2^+$, $^3/_2^+$, ($^5/_2^+$), ($^5/_2^-$), ($^1/_2^+$), ($^5/_2^+$), and ($^{11}/_2^+$) for the states in ^{23}Mg at 2.71, 2.90, 3.86, 3.97, 4.68, 5.29, and 5.45 MeV, respectively. (auth)

6460 ELASTIC SCATTERING OF ALPHA PARTICLES FROM ^{27}Al IN THE ENERGY RANGE 21 TO 28 MeV. Kemper, K. W.; Obst, A. W.; White, R. L. (Florida State Univ., Tallahassee). Phys. Rev., C; 6: No. 6, 2090-5(Dec 1972).

Sixty-point angular distributions were measured in 200-keV steps for ^{27}Al(α,α_0)^{27}Al in the energy range 21 to 28 MeV. At an incident energy of 23.9 MeV an anomalous structure of full width at half maximum ~300 keV is seen for angles greater than 90°, but above 25 MeV no correlated structure is seen. The data above 25 MeV were analyzed in terms of the optical model; and discrete potential ambiguities, as well as a radius ambiguity, were found. These potential parameter sets were able to give qualitative fits to the data throughout the angular range 25 to 150° (c.m.) at the energies 24.9, 25.9, and 27.5 MeV, and at the lower energies 22.3 and 23.3 MeV the general trend of the data was reproduced. (auth)

6461 FOURTH SYMPOSIUM ON THE STRUCTURE OF LOW-MEDIUM MASS NUCLEI. Conference Held at Lawrence, Kansas, October 12-14, 1970. Davidson, J. P. (ed.). Lawrence, Kansas; University Press of Kansas (1972). 273p. $15.00. (CONF-701073).

Separate abstracts were prepared for eleven of the twelve papers presented at this symposium. The remaining one, describing an approach to software modularity in data acquisition, was not in the subject scope of NSA. (R.W.R.)

For abstracts of individual papers see: 6445, 6446, 6462-6465, 6484, 6485, and 6603-6605.

6462 NEGATIVE PARITY STATES IN ODD-A NUCLEI. Castel, B. (Queen's Univ., Kingston, Ont.). pp 26-9 of Fourth Symposium on the Structure of Low-Medium Mass Nuclei. /Davidson, J. P. (ed.). Lawrence, Kan.; University Press of Kansas (1972).

From fourth symposium on the structure of low-medium mass nuclei; Lawrence, KS. (12 Oct 1970). See CONF-701073.

Low-lying negative-parity states in odd-A nuclei in the 2s-1d shell are discussed in a core-quasi-particle model. The coupling of octupole phonon states to the single-quasi-particle states is included. The decay properties of the $^7/_2^-$ state in ^{33}Cl are correctly described. (2 figures, 1 table) (R.W.R.)

6463 LIFETIMES OF BOUND STATES. Segel, R. E. (Argonne National Lab., Ill.). pp 112-45 of Fourth Symposium on the Structure of Low-Medium Mass Nuclei. /Davidson, J. P. (ed.). Lawrence, Kan.; University Press of Kansas (1972).

From fourth symposium on the structure of low-medium mass nuclei; Lawrence, KS. (12 Oct 1970). See CONF-701073.

Data on bound-state lifetimes are first collected; and some overall features, such as average transition rates and isospin effects, are presented. Significant features of specific nuclei are then discussed, in the rotational region, the spherical region (effective charges and effective moments), and the remainder of the sd shell. The inhibition established in the upper part of the periodic table for M2's does not seem to hold below A = 40. There is often very good agreement when a rigid-rotator model is used in the 19 ≤ A ≤ 26 region for data fitting. In several cases the relative transition rates can be calculated to within the accuracy of the experimental data, which is, in places, as good as 30%. A glaring exception is ^{23}Na. At the ends of the shell, the spherical shell model should be valid; yet even when effective moments are used in ^{38}Cl and ^{40}K, the relative transition rates cannot be reproduced to within a factor of 2.5. This seriously limits what one can expect from calculations using effective charges and effective moments. (17 figures, 5 tables) (R.W.R.)

6464 HARTREE-FOCK CALCULATIONS IN THE 2s-1d SHELL. Krieger, S. J. (Univ. of Illinois, Chicago). pp 146-65 of Fourth Symposium on the Structure of Low-Medium Mass Nuclei. /Davidson, J. P. (ed.). Lawrence, Kan.; University Press of Kansas (1972).

From fourth symposium on the structure of low-medium mass nuclei; Lawrence, KS. (12 Oct 1970). See CONF-701073.

Present theoretical understanding of the nucleon-nucleon interaction as derived from Hartree-Fock calculations is discussed first. Calculations for nuclei in the 2s-1d shell are then described. The two-body potential used was derived from free two-nucleon data. In addition to varying the orbits of all particles, the calculation used a basis for which the effects of truncation are minimal so that the deformations found are not limited by restrictions on the space of the Hartree-Fock wave function. Methods which may be used to explore the various solutions to the Hartree-Fock equations are considered. The results given use a basis of oscillator functions with $n_x + n_y + n_z \leq 2$; no significant improvement was obtained by including the next higher set of functions.

Binding energies, rms radii, electric quadrupole moments, and angular momenta for the ground state of A = 4n nuclei from ^{4}He to ^{40}Ca are presented, along with single-particle energy levels for ^{12}C to ^{40}Ca and a comparison of nuclear deformations. (5 figures, 5 tables) (R.W.R.)

6465 ALPHA PARTICLE CAPTURE IN THE 2s–1d SHELL. Endt, P. M. (State Univ., Utrecht). pp 209-23 of Fourth Symposium on the Structure of Low-Medium Mass Nuclei. /Davidson, J. P. (ed.). Lawrence, Kan.; University Press of Kansas (1972).

From fourth symposium on the structure of low-medium mass nuclei; Lawrence, KS. (12 Oct 1970). See CONF-701073.

Alpha particle capture by odd-A nuclei, particularly ^{23}Na and ^{27}Al, measured with Ge(Li) detectors is discussed. It is found that the only resonances which can be seen in (α,γ) reactions are high-spin resonances. The determination of spins and parities is included. The latter part of the paper discusses shell-model calculations for these nuclei. (no figures) (R.W.R.)

6466 OPTICAL MODEL ANALYSIS OF CROSS SECTION AND VECTOR ANALYZING POWER MEASUREMENTS FOR ELASTICALLY SCATTERED DEUTERONS. Lohr, J. M. Madison, Wis.; Univ. of Wisconsin (1972). 252p. University Microfilms Order No. 72-22,103.

Thesis.

Cross section and vector analyzing power measurements were made for polarized deuterons scattered elastically from ^{27}Al, Si, ^{46}Ti, ^{48}Ti, ^{53}Cr, ^{68}Zn, ^{90}Zr and ^{120}Sn at incident deuteron energies of 9, 11 and 13 MeV. The beam polarization was measured continuously with a ^{4}He polarimeter. These data sets were supplemented by an additional 30 sets of cross section and vector analyzing power measurements from other experiments and all the data was subjected to analysis with the optical model. The additional data sets increased the energy range covered in the final analysis to between 5 and 13 MeV and the range of target masses to between A = 27 and A = 208. An optical potential with surface absorption and an $\vec{l} \cdot \vec{s}$ term was used in the analysis. Good fits to the data were obtained with the strength and geometry of the absorptive term allowed to vary freely and with the real central strength given by $V = 91.13 + 2.20\ Z/A^{\frac{1}{3}}$. The other parameters were fixed for the final analyses at $r_0 = 1.05$ fm, $a_0 = 0.86$ fm, $V_{so} = 7.0$ MeV, $r_{so} = 0.75$ fm, $a_{so} = 0.5$ fm and $r_c = 1.3$ fm. Parameterization of the absorptive terms as linear functions of A resulted in deteriorated fits to a number of the data sets, particularly those for which the bombarding energy was near the Coulomb barrier. With the potential parameters given above, and $W_D = 18.55 - 0.06A$ MeV, $r_w = 1.41 + 0.00019A$ fm and $a_w = 0.49 - 0.037A$ fm, reasonable good fits were obtained, particularly in the mass region near A = 50. No consistent dependence of any of the potential parameters on bombarding energy was observed for the targets with $A \geq 46$. A strong correlation was demonstrated between the volume integral per nucleon of the imaginary potential and the quadrupole deformation parameter β_2. Computer experiments on the optical potential showed that for deuteron scattering V_{so} does not rigorously act as a scale factor for $iT_{11}(\theta)$, and that more attention might need to be given to the Coulomb term, particular for bombarding energies where the Coulomb barrier is important. Values of $\sigma(\theta)$ and $iT_{11}(\theta)$ measured in the experiment are tabulated, as are values of the potential parameters obtained for searches with different numbers of these parameters allowed to vary to obtain fits. (Diss. Abstr. Int., B)

6467 α-SPALLATION CROSS SECTIONS AT 920 MeV (230 MeV/N) IN ^{27}Al, ^{16}O, ^{12}C, AND ^{9}Be, AND APPLICATION TO COSMIC RAY TRANSPORT. Radin, J. R. New York, N. Y.; New York Univ. (1972). 129p. University Microfilms Order No. 72-21,534.

Thesis.

Thin-sandwich targets were exposed in the external 920-MeV α-particle beam at the 184-in. cyclotron at Lawrence Radiation Laboratory. First, the cross section for the primary beam-monitor reaction, $^{12}C(\alpha,\alpha n)^{11}C$, was determined by exposing sandwiches of plastic scintillator and Ilford 100μ L4 pellicles to the beam. The beam flux was determined from a scan of the vertical tracks in the pellicle. Second, cross sections for the production of ^{18}F in ^{27}Al; ^{15}O, ^{13}N, ^{11}C, ^{7}Be in ^{16}O; ^{7}Be in ^{12}C; and ^{7}Be in ^{9}Be were measured. Third, the results were generalized to cover all of the α-spallation cross sections in the L ($3 \leq Z \leq 5$) and M ($6 \leq Z \leq 9$) groups and were applied to an analysis of the effect of the He/H + He ratio of the interstellar gas on the cosmic ray transport phenomena. (Diss. Abstr. Int., B)

6468 STUDY OF THE ^{27}Al(^{3}He,p)^{29}Si REACTION. Nann, H. (Univ., Frankfurt am Main); Mozgovoy, T.; Bass, R.; Wildenthal, B. H. Nucl. Phys., A192: No. 2, 417-25(1972).

The ^{27}Al(^{3}He,p)^{29}Si reaction has been studied at bombarding energies between 9 and 14 MeV. Comparison of the experimental angular distributions at 14 MeV incident energy with two-nucleon transfer distorted-wave Born approximation (DWBA) calculations is made to test shell-model wave functions of the target ground state and the residual ground and excited states. (auth)

6469 RESONANT ABSORPTION OF THE γ-RADIATION FROM THE ^{22}Ne(p,γ)^{23}Na REACTION AND THE EFFECT OF RUTHERFORD SCATTERING IN THE TARGET ON THE WIDTH OF THE ABSORPTION CURVES. du Toit, Z. B.; de Kock, P. R.; Hough, J. H.; Mouton, W. L. (Univ. of Stellenbosch, S. Afr.). Z. Phys.; 255: No. 2, 97-102(1972).

Gamma rays of energy 9.404 and 9.700 MeV were obtained from the reaction ^{22}Ne(p,γ)^{23}Na at proton energies of 640 and 950 keV respectively and were resonantly absorbed in sodium metal. Isotopically separated ^{22}Ne targets on nickel backings were used. The following level widths for ^{23}Na were obtained: The 9.404 MeV level: $\Gamma = 65 \pm 40$ eV, $\Gamma_\gamma = 2.2 \pm 0.7$ eV. The 9.700 MeV level: $\Gamma = 9.5^{+4.1}_{-3.8}$ eV, $\Gamma_\gamma = 5.6^{+1.1}_{-0.8}$ eV. The disagreement between the results for the 9.404 MeV level and the previously determined values can probably be ascribed to proton scattering in the window of the gas target used in the latter measurement. (auth)

6470 OCTUPOLE EXCITATION OF THE 6.88 LEVEL OF ^{28}Si BY DEUTERON INELASTIC SCATTERING AT 29.5 MeV. Perrin, G.; Nguyen Van Sen; ; Arvieux, J.; (and others) (Institut des Sciences Nucleaires, Grenoble, France). Lett. Nuovo Cim.; 4: No. 9, 381-4(1 Jul 1972).

Deuteron spectra and angular distributions were measured for deuteron inelastic scattering from the ^{28}Si 6.88 MeV level at an incident energy of 29.5 MeV. DWBA calculations support the hypothesis of octupole excitation of this level. (J.W.R.)

6471 STUDIES OF LOW-LYING LEVELS OF ^{33}S BY THE ^{30}Si(α,nγ)^{33}S REACTION. Hirko, R. G. (Stanford Univ., Calif.); Jones, A. D. W. Nucl. Phys., A192: No. 2, 329-40(1972).

The ^{30}Si(α,nγ)^{33}S reaction was used to investigate ^{33}S levels up to 4.3 MeV excitation energy. Each individual state was populated in turn with bombarding energies chosen to be sufficiently near threshold that neutrons of low-order angular momentum were emitted. Accurate excitation energies were determined. The angular distributions of γ-rays de-exciting these levels were analyzed according to standard angular-correlation theory. Experimental results include the spin limitations: $J^\pi(2969) = {}^7/_2{}^+$, $J(4048) = {}^5/_2$ or ${}^9/_2$, $J(4094) \geq {}^9/_2$, $J(4142) = {}^3/_2$ or ${}^5/_2$. It is concluded that there exist two levels in ^{33}S near 4.05 MeV excitation energy with a separation of 5 ± 4 keV. The mixing-ratio determinations permit a critical comparison of recent shell-model calculations with the experimental data. The calculations are in reasonably good agreement with the experimental data. (auth)

6472 ELECTROMAGNETIC TRANSITION STRENGTHS IN ^{35}Cl. Broude, C.; Forster, J. S.; Ingebretsen, F. (Chalk River Nuclear Lab., Ont.). Nucl. Phys., A192: No. 2, 291-304(1972).

Mean nuclear lifetimes have been measured for nine levels in ^{35}Cl and lower limits determined for two other levels using the Doppler-shift attenuation method. Levels in ^{35}Cl were populated via the ^{32}S(α,p)^{35}Cl reaction at an α-particle bombarding energy of 10.0 MeV. Branching ratios and excitation energies have also been determined for many of the levels. The results of the lifetime measurements are: 2695 keV, 70 ± 30 fs; 3003 keV, 48 ± 9 fs; 3915 keV, <22 fs; 3942 keV, 330 ± 50 fs; 3968 keV, <54 fs; 4058 keV, 31 ± 13 fs; 4108 keV, 70 ± 16 fs; 4171 keV, 68 ± 24 fs; 4348 keV, 2.9 ps; 4618 keV, 58 ± 24 fs; 4882 keV, 280 ± 60 fs. The results are in reasonable agreement with theoretical predictions. (auth)

6473 STUDY OF γ-RAYS OF ^{37}Ar. Wong, E.; Robertson, B. C.; Iyengar, K. V. K.; Sheppard, D. M.; Olsen, W. C. (Univ. of Alberta, Edmonton). Nucl. Phys., A192: No. 2, 279-90(1972).

The mean lifetime of levels in ^{37}Ar below 3.30 MeV excitation were measured via the ^{37}Cl(p,nγ)^{37}Ar reaction with the Doppler-shift attenuation method. Gamma-ray angular distributions were obtained at various incident energies and compared with the predictions of the statistical compound nuclear model. The angular distribution and lifetime results yield an assignment of $J^\pi = {}^5/_2{}^{(+)}$ for the 3.171 MeV level and $J^\pi = {}^9/_2{}^-$ for the 3.185 MeV level. The experimental results are discussed and compared with shell-model calculations. (auth)

6474 TESTING OF PHOTON PRODUCTION DATA FROM ENDF/B-III MATERIAL 1135 (^{27}Al). Ford III, W. E. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 963-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6475 INVESTIGATION OF ^{33}Cl EXCITED STATES BY THE METHOD OF POLARIZED PROTON ELASTIC SCATTERING BY ^{32}S NUCLEI. Lopatko, I. D.; Borovlev, V. I.; Andreev, G. B.; Slabospitskii, R. P. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 16: No. 2, 231-3(Aug 1972). (In Russian).

An investigation of elastic scattering of polarized protons on ^{32}S nuclei at E_p = 2.5 to 3.0 MeV was carried out for two scattering angles θ_{cms} = 90 and 120°. It has been found that the values of the total angular moments and parities of ^{33}Cl excited states at E_p = 2,580 and 2,902 MeV equal $J^\pi = 7/2$ for both states. The resonance parameters at E_p = 2,814 and 2,917 MeV are confirmed; the resonance energy (E_{res} = 2930 ± 15 keV) and the resonance total width (Γ = 283 ± 30 keV) at E_p = 2,930 MeV were clarified. Using the resonance parameters obtained in the present experiment, a polarization map for E_p = 2.5 to 3.0 MeV has been calculated. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 5345, 5821, 6451, 6453, 6456, 6461, 6464, 6466, 6509, 6534, and 6587.

6476 INVESTIGATIONS ON THE REORIENTATION EFFECT IN COULOMB EXCITATION IN THE NUCLEI ^{56}Fe AND ^{53}Cr. Thomson, James Alan Jr. Lafayette, Ind.; Purdue Univ. (1972). 167p. University Microfilms Order No. 72-21,288.

Thesis.

The reorientation effect in Coulomb excitation was studied in the nuclei ^{56}Fe and ^{53}Cr to determine the static quadrupole moment of a state in each of these nuclei and to attempt to resolve some fundamental questions about the reliability of this technique as a method for determining nuclear static quadrupole moments. The dependence of the reorientation effect on bombarding energy was studied by observing the Coulomb excitation of the 0.847 MeV 2^+ state of ^{56}Fe induced by ^{16}O projectiles in the energy range of 22 to 40 MeV. It was found that the nuclear force can be ruled out and that reorientation effect experiments can be safely performed if an appropriate separation of projectile and target nuclei given by $2a = R_0(A_1^{\frac{1}{3}} + A_2^{\frac{1}{3}}) + \Delta$, where 2a is the distance of closest approach, R_0 = 1.2 fm, and $\Delta \geq 3.5$ fm, is maintained. Very erroneous static quadrupole moment values can be extracted from Coulomb excitation experiments if this criterion is not strictly followed. The static quadrupole moment of the 0.847 MeV 2^+ state of ^{56}Fe was determined to be Q = 0.23 ± 0.03 barns from experiments using 25.0 and 27.5 MeV ^{16}O projectiles and 56.0 MeV ^{32}S projectiles. By observing the Coulomb excitation of the 0.564 MeV $1/2^-$ state of ^{53}Cr induced by 55.0 and 59.0 MeV ^{32}S projectiles, the static quadrupole moment of the $3/2^-$ ground state was determined to be Q = +0.04 ± 0.06 barns. The agreement between this result and the results of different experimental techniques indicates that there are no large competing effects in this reorientation effect measurement. (Diss. Abstr. Int., B)

6477 NUCLEAR SPECTROSCOPIC STUDIES OF SHORT-LIVED NEUTRON-DEFICIENT SPECIES IN THE $f_{\frac{7}{2}}$-SHELL REGION. Black, Jerry Nelson. East Lansing, Mich.; Michigan State Univ. (1971). 300p. University Microfilms Order No. 72-22,190.

Thesis.

The decay schemes of ^{53g}Fe and ^{53m}Fe were studied by the use of standard techniques for β- and γ-ray spectroscopy. The γ-decay of ^{40}Sc also was investigated by means of on-line, pulsed-beam techniques. An extensive search was conducted for γ-ray evidence to support the existence of high-spin metastable states in ^{53}Co, ^{43}Ti and ^{43}Sc. At least two new γ-rays were observed in the decay of 8.5 m ^{53g}Fe. These γ-rays allowed the establishment of a decay scheme with levels at 0, 377.9, 1288.0 and 1619.0 keV. The β^+ decay was found to have end-point energies of 2.8, 2.4 and 1.7 MeV. Subsequent $\beta^+ - \gamma$ coincidence experiments demonstrated that the 2.8- and 2.4-MeV groups feed the ground state and first excited state, respectively. The decay of 2.5 m ^{53m}Fe was found to have six γ rays which could be placed in a consistent decay scheme with levels at 0, 1328.1, 2339.6 and 3040.6 keV. Careful examination of the γ rays de-exciting this $19/2^-$ metastable state resulted in the direct observation of transitions of multipolarities of M5 and E6—the highest ever observed experimentally. The Oak Ridge Shell Model Code of French, et al., was utilized to predict the level schemes of ^{53}Mn and ^{53}Fe. The results were compared with other calculations and with the experimentally determined values. Partial half-lives for the γ rays de-exciting ^{53m}Fe also were calculated and compared with experimental results. Using on-line, pulsed-beam techniques, seven γ rays were observed in the decay of 0.183 s ^{40}Sc, and subsequently placed in a consistent decay scheme with levels at 0, 3736.9, 4491.3, 5612.7 and 7656.3 keV. Based on the γ-ray intensities observed, β^+ feeding values and log ft values were deduced. Various γ-ray techniques were used to conduct an exhaustive search for three-particle metastable states analogous to that observed in ^{53m}Fe. The nuclei ^{53}Co, ^{43}Ti and ^{43}Sc were studied carefully in order to determine if γ rays were present which could be attributed to the decay of metastable states. The results of this study failed to establish the existence of γ rays which could be attributed to such states in these nuclei. If these states exist, then either the γ-branch of their decay is very small or the cross section for their formation by the reactions used is very low. (Diss. Abstr. Int., B)

6478 MEASUREMENT OF ATOMIC MASSES IN THE REGION FROM TITANIUM TO IRON. Demirkhanov, R. A.; Dorokhov, V. V.; Dzkuya, M. I. Yadern. Fiz.; 15: No. 5, 849-55(May 1972). (In Russian).

The masses of all the stable isotopes of titanium, vanadium, chromium, manganese and iron were measured by the mass-spectrographic method. The measurements were carried out with a doublet method. Organic compounds of various composition were used as standards. Every isotope mass was measured with using of 4–6 doublets of various content and origin. The consistency of the data obtained for the every multiisotope element was controlled with isotope doublets. In all, 82 basis doublets were measured and the masses of 16 isotopes Ti, V, Cr, Mn and Fe were determined with their help. A relative $\Delta M/M \simeq 2 \times 10^{-7}$ was obtained in the total measured mass region. (auth)

6479 GAMMA-RAY DOPPLER-SHIFT MEASUREMENTS IN ^{43}Ca. Kavanagh, R. W.; Schulz, N.; Merdinger, J. C. (CRN, Strasbourg). Nucl. Phys.; A195: No. 1, 302-10(1972).

States of ^{43}Ca were excited via the ^{40}Ar(α,n) reaction, with natural argon as common target and stopping medium, and with bombarding energies close to thresholds. The following mean lives were obtained by the Doppler-shift attenuation method for the 593, 990, and 1395 keV levels: 103 ± 13, 65 ± 8 and 4.9 ± 0.9 ps. Upper limits of 12 ps were set for the lifetimes of the 1678, 1902, 1931, 2046, 2067, 2094 and 2249 keV levels. Spin values and possible configurations of the ^{43}Ca levels are discussed in the light of these results. (auth)

6480 PHOTOALPHA REACTIONS IN THE REGION Z = 22 TO 30. Keller, N. A.; McConnell, D. B. (Univ. of Toronto). Can. J. Phys.; 50: No. 13, 1554-67(1 Jul 1972).

The yields and angular distributions of photoalphas from seven elements in the region Z = 22–30 were investigated experimentally. Strong anisotropies in the angular distributions from the even-even nuclei were observed. Improved statistical model calculations using the known spins and parities of the low lying levels of the even-even daughters give good agreement with the experimental results. (auth) (Canada)

6481 RADIATIVE CAPTURE OF THERMAL NEUTRONS BY TITANIUM ISOTOPES. Knats'ko, U. A.; Nyagrei, S. A.; Rudak, E. A.; Khil'manovich, A. M. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 3, 79-84 (1972). (In Ukrainian).

Gamma spectra from (n,γ) reactions involving Ti isotopes were studied with a Ge(Li) detector at the IRT reactor (Belorussian SSR). The energy and intensity of the γ rays were measured. A scheme of γ decay of the capture state is proposed. The mechanism of neutron capture is discussed. (tr-auth)

6482 LIMITING ANGULAR MOMENTA FOR THE REACTIONS OF 45- TO 180-MeV ^{12}C PROJECTILES WITH Al, Ti, Ni, AND Cu. Natowitz, J. B.; Chulick, E. T.; Namboodiri, M. N. (Texas A and M Univ., College Station). Phys. Rev., C; 6: No. 6, 2133-9(Dec 1972).

Cross sections for complete fusion were measured for the reactions of ^{27}Al, ^{48}Ti, Cu, and Ni target nuclei with ^{12}C projectiles accelerated by the Texas A&M variable-energy cyclotron. Both mica track detectors and solid-state detectors were used to measure energy spectra, range distributions, and angular distributions for the recoiling product nuclei. The limiting angular momentum, J_{crit}, above which complete fusion does not occur is derived by using a sharp cutoff model. This limiting angular momentum is found to increase slowly with excitation energy. Possible interpretations of this energy dependence are discussed. (auth)

6483 DECAY OF THE LOWEST T = 2 STATE IN ^{44}Ti. Simpson, J. J. (Univ. of Guelph, Can.); Dixon, W. R.; Storey, R. S. (Phys. Rev. Lett.; 29: No. 21, 1472-4(20 Nov 1972).

The lowest T = 2 state in ^{44}Ti was found in the reaction ^{40}Ca $(\alpha,\gamma)^{44}$Ti at an excitation energy of 9338 ± 2 keV in ^{44}Ti. The radiative yield was measured and the γ decay, studied. (auth)

6484 ALPHA SCATTERING AND NUCLEAR STRUCTURE IN THE CALCIUM REGION. Santo, R. (Univ., Munich); Gaul, G.; Ludecke, H.; Schmeing, H.; Stock, R. pp 173-83 of Fourth Symposium on the Structure of Low-Medium Mass Nuclei. /Davidson, J. P. (ed.). Lawrence, Kan.; University Press of Kansas (1972).

From fourth symposium on the structure of low-medium mass nuclei; Lawrence, KS. (12 Oct 1970). See CONF-701073.

An optical-model analysis was made for alpha elastic scattering by ^{40}Ca and ^{44}Ca at 18.0, 22.0, 24.1, and 29.0 MeV. Examination of the entire angular distributions up to 180° shows large differences between the isotopes; doubly magic ^{40}Ca is anomalous, whereas the ^{44}Ca curve fits well into the systematics for heavier nuclei and, consequently, is fitted by the average potential. A similar study of ^{36}Ar and ^{40}Ar at 18.0, 22.1, 24.1, and 29.2 MeV again shows a backward rise, this time for ^{36}Ar. Comparison of the data shows the following: there is a great similarity between the N = Z nuclei on the one hand and the N = Z + 4 nuclei on the other; the N = Z group shows the backward rise, whereas the N = Z + 4 group behaves regularly; the previously observed close correspondence between the angular distributions from ^{40}Ca and ^{39}K extends to their N + 2 isotopes. If the imaginary potential is considerably reduced in the surface region, the cross section at back angles is increased. Thus, by arbitrarily varying the parameters of the optical-model potential, anomalous data can be fitted, but rather different parameters are required to fit each energy. In addition, the fit to the back angles is paid for by a worse fit at forward angles. The observed anomalies, therefore, lie outside the domain of the simple optical model. An attempt to fit the ^{40}Ca data by using an l-dependent imaginary potential did not succeed. Possible effects of alpha correlations in the target nuclei were described phenomenologically by adding a Gaussian potential centered near the surface to the average potential. With fixed values of this additional potential the entire angular distributions of the ^{40}Ca data at all four energies were rather well described. Alpha inelastic scattering by ^{40}Ca was measured at 29 MeV. The results for different states fall into several groups, depending on back-angle behavior. In general, the cross sections at large angles are much larger and more structured than DWBA predictions. It appears that the microscopic structure of the excited states and the specific way in which they are excited in alpha scattering must be responsible for the behavior at large angles. (4 figures) (R.W.R.)

6485 COLLECTIVE CALCULATIONS IN LIGHT AND INTERMEDIATE MASS NUCLEI. Zamick, L. (Rutgers-The State Univ., New Brunswick, N. J.). pp 184-208 of Fourth Symposium on the Structure of Low-Medium Mass Nuclei. /Davidson, J. P. (ed.). Lawrence, Kan.; University Press of Kansas (1972).

From fourth symposium on the structure of low-medium mass nuclei; Lawrence, KS. (12 Oct 1970). See CONF-701073.

The coupling of particles to vibrations in light and intermediate nuclei is discussed. It is shown that the intuitive idea of (generalized) effective charge breaks down due to configuration mixing by citing examples in the fp shell. Isoscalar and isovector vibrations in closed-shell nuclei are next considered in Hartree-Fock, RPA, and hydrodynamical models. The problem of effective charge and core renormalization of the two-body force in particle-vibration coupling is then addressed. Finally, calculations devoted to negative-parity vibrations and particles coupled to them are described. (9 figures, 3 tables) (R.W.R.)

6486 CHARGED PARTICLE SPECTRA AND LEVEL DENSITIES OF NUCLEI NEAR Z = 28; CARBON AND OXYGEN ANALYSIS OF THIN METAL FOILS. Kennedy, Albert Joseph. Lafayette, Ind.; Purdue Univ. (1972). 229p. University Microfilms Order No. 72-21,220.

Thesis.

Energy spectra and angular distributions were determined for the (p,p′) and (p,α) 14 MeV proton induced reactions on the following targets: ^{55}Mn, ^{56}Fe, and ^{58}Ni (N = 30); ^{59}Co (N = 32); and ^{62}Ni, ^{63}Cu, and ^{64}Zn (N = 34). 16.5 MeV alpha particles were used to measure the charged particle energy spectra of the ^{59}Co(α,α') and ^{56}Fe(α,p) reactions. These reactions were analyzed in terms of the spin independent and spin dependent statistical theories of nuclear reactions. Modifications were made to the spin dependent calculations in order to conserve isospin. The sensitivity of the theoretically calculated energy spectra to the various parameters of the theory was investigated. The level density parameter and pairing energy of the ^{59}Co nucleus were determined to be 7.5 MeV^{-1} and 1.29 MeV respectively by fitting the experimental spectra of the ^{56}Fe(α,p), ^{59}Co(α,α'), ^{59}Co(p,p′), and ^{62}Ni(p,α) reactions with the theoretically calculated cross sections. The level density parameters for the other reaction products were also determined. No evidence was found for the effect of the Z = 28 shell on the values of the level density parameter. The contribution of pre-equilibrium emission to the experimental energy spectrum was determined to vary between 20 and 45% for the (p,p′) reactions. Proton induced nuclear reactions were used to detect light element impurities in thin metal foils. Oxygen and carbon were determined in thin metal foils with a sensitivity of about 10 ppM. Impurities concentrated on the surface of the metal foils could be distinguished from impurities diffused throughout the body of the metal foil. (Diss. Abstr. Int., B)

6487 EXCITATION CURVES AND THICK-TARGET YIELD CURVES OF ^{52}Fe, ^{55}Fe, ^{56}Mn, ^{48}Cr, ^{49}Cr, ^{51}Cr, AND ^{48}V FOR THE (Cr + ^{3}He) REACTIONS ON NATURAL CHROMIUM. Akiha, Fumimasa (Hirosaki Univ., Japan); Murakami, Yukio. Nippon Kagaku Kaishi; No. 8, 1416-21(Aug 1972). (In Japanese).

The excitation curves and thick-target yield curves were measured for the formation of ^{52}Fe and other radioisotopes such as ^{55}Fe, ^{56}Mn, ^{48}Cr, ^{49}Cr, ^{51}Cr and ^{48}V, formed while bombarded with ^{3}He particles up to 44 MeV. Also various conditions in the production procedure, especially the yield of ^{52}Fe and other byproduced radioisotopes under most adequate incident energy, were examined. The method used was as follows: the stacked metallic chromium plates (each of ϕ 30 mm, 20-40 mg/cm^2) were made into sufficient thick-target for the bombardment in the ranges of the incident particle energy in the cyclotron, followed by chemical separation of the iron radioactivities. The activities of relative long-lived products formed in each target were measured with a calibrated scintillation counter and proportional counter. The excitation curve of ^{52}Fe shows a maximum of 5 mb near 35 MeV energy. The average thick-target yields of ^{52}Fe for 40 MeV incident energy is 50 μCi/μAhr and the ^{55}Fe/^{52}Fe ratio is 0.07%. It is a superior advantage for medical use that this ratio is very small in comparison with that for α-particle bombardment on a natural chromium target. Thus the production method of ^{52}Fe via the ^{3}He-reaction on natural chromium proved to be superior to other possible reactions in its high yields as well as in other points. (auth)

6488 CALCULATIONS OF NEUTRON AND GAMMA-RAY-PRODUCTION CROSS SECTIONS FOR CALCIUM AND LEAD. Fu, C. Y.; Perey, F. G. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 961-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 5431, 6438, 6451, 6453, 6466, 6480, 6486, 6509, 6534, and 6587.

6489 ISOBARIC ANALOGUE STATES IN GALLIUM NUCLEI. Ragan, Gary Eugene. Charlottesville, Va.; Univ. of Virginia (1972). 129p. University Microfilms Order No. 72-22,641.

Thesis.

The gross structure of isobaric analog states has been observed in proton elastic scattering from targets of ^{66}Zn, ^{68}Zn, and ^{70}Zn. In addition, fine structure has been observed in proton elastic scattering from a target of ^{64}Zn. The levels thus observed as compound nucleus resonances in ^{67}Ga, ^{69}Ga, ^{71}Ga, and ^{65}Ga are analogs of low-lying levels of ^{67}Zn, ^{69}Zn, ^{71}Zn, and ^{65}Zn. Resonance parameters, Coulomb displacement energies, and spectroscopic factors have been extracted. Results are compared with (d,p) studies on the respective target nuclei. The level density of the observed fine structure in the region of the $J^\pi = 1/2^+$, $E_{ex.}$ = 1.911 MeV state in ^{65}Ga is shown to be consistent with semi-empirical predictions. (Diss. Abstr. Int., B)

6490 ISOBARIC ANALOG STATES IN THE ^{88}Sr(p,n)^{88}Y AND ^{88}Sr(p,p)^{88}Sr REACTIONS. Proffitt, Ronald Ray. Lexington, Ky.; Univ. of Kentucky (1971). 55p. University Microfilms Order No. 72-9407.

Thesis.

The theory of isobaric analog resonances, originally due to Robson, is modified and extended. The modified and extended theory is used to fit experimental results for the total (p,n) cross section in the ^{88}Sr(p,n)^{88}Y reaction and to fit experimental results for the differential elastic scattering cross sections at 90 and 180 degrees in the ^{88}Sr(p,p)^{88}Sr reaction in the proton bombarding energy range from 4.4 to 8.0 MeV. In the extension and modification of the theory, the inelastic proton channels are taken into ac-

count leading to new expressions for the enhanced transmission coefficients. These new expressions are then used in conjunction with the statistical theory, originally developed by Hauser and Feshbach, to obtain excellent fits to the above mentioned experimental data. (Diss. Abstr. Int., B)

6491 ISOSPIN IMPURITY OF THE ^{64}Ga GROUND STATE. Yap, C. T.; Tee, C. S. (Univ. of Singapore). Nucl. Phys.; A194: No. 3, 573-6(1972).

The Fermi matrix element for the $(0^+)\beta(0^+)$ ground state to ground state transition in ^{64}Ga has been found experimentally to be exceptionally large and the theoretical value in the Nilsson scheme is in reasonable agreement with that from experiment. (auth)

6492 LEVELS AND γ-TRANSITIONS IN THE NUCLEUS OF ^{64}Cu FROM REACTION ^{64}Ni(p,nγ)^{64}Cu. Guzhovskii, B. Ya.; Abramovich, S. N.; Zvenigorodskii, A. G.; Trusillo, S. V. Yadern. Fiz.; 16: No. 2, 225-30(Aug 1972). (In Russian).

The structure and γ-decay of levels of ^{64}Cu excited in ^{64}Ni(p,nγ) reactions near isobar-analog resonances of E_p = 3.47 to 3.54; 3.83 to 3.94; 4.59 to 4.68 and 5.025 to 5.19 MeV have been studied. The measurements of γ-spectra in the energy range 100 to 2550 keV have been done with a Ge(Li) detector with a sensitive volume of 30 cm^3 and resolution efficiency 5 keV for 1332 keV. About 70 new γ-transitions have been found and identified. The values of energy levels below 2.5 MeV have been specified. The most probable γ-transitions are exhibited taking as a base energy correlation. It is shown that a selective resonance character of excitation functions for some γ-transition over the studied range of energy takes place. (auth)

6493 NUCLEAR REACTIONS CAUSED BY α PARTICLES ON ^{59}Co NUCLEUS. Zhukova, O. A.; Kanashevich, V. I.; Laptev, S. V.; Churcin, G. P. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz.; 16: No. 2, 242-8(Aug 1972). (In Russian).

The excitation function and average changes of recoil nuclei produced in nuclear reactions of α-particle on ^{59}Co were studied. Experimental values of the cross sections for the reactions studied are compared with those calculated with the help of statistical theory using three different forms of dependence of nuclear level densities upon excitation energy. (auth)

6494 DECAY OF $^{76\ 78\ 80}$As. McMillan, Donald Kenneth. Burnaby, B. C.; Simon Fraser Univ. (1971). National Library of Canada, Ottawa.

Thesis.

The β- and γ-decay properties of the neutron-rich isotopes ^{76}As, ^{78}As and ^{80}As have been studied using high resolution Ge(Li) and Si(Li) semi-conductor detectors and a superconducting magnet beta spectrometer. Beta-γ, γ-γ and single detector measurements have allowed the assembly of decay schemes for ^{78}As and ^{80}As and the clarification of some aspects of the previously postulated decay scheme of ^{76}As. Theoretical interpretations of the proposed excited levels of these nuclei have been made in terms of the Davydov and Chaban model. (Diss. Abstr. Int., B)

6495 INTERNAL CONVERSION MEASUREMENTS ON ^{83m}Kr. Kolk, B.; Pleiter, F.; Heeringa, W. (Rijksuniversiteit, Groningen, Netherlands). Nucl. Phys.; A194: No. 3, 614-24(1972).

A conversion coefficient $\alpha = 19.6 \pm 0.7$ has been measured for the 9.4-keV transition in ^{83m}Kr, yielding a resonance cross section of $(1.08 \pm 0.04) \times 10^{-18}$ cm^2. This cross section is of interest for the evaluation of Mössbauer measurements of the recoilless fraction of the 9.4 keV transition. From the M_1/M_{23} conversion ratio a mixing ratio $\delta^2(E2/M1) = (2.2 \pm 0.5) \times 10^{-4}$ has been derived. For the 32 keV transition conversion ratios have been determined. Accurate transition energies $E_{\gamma 1} = 32.14 \pm 0.05$ keV and $E_{\gamma 2} = 9.40 \pm 0.01$ keV have been obtained. Re-evaluation of the K X-fluorescence yield of krypton gives $\omega_K = 0.660 \pm 0.012$. (auth)

6496 LEVELS OF ^{86}Kr FROM ^{87}Rb(t,α)^{86}Kr. Tucker, A. B. (California State Univ., San Jose); Apt, K. E.; Knight, J. D.; Orth, C. J. Phys. Rev., C; 6: No. 6, 2075-81(Dec 1972).

The levels of ^{86}Kr were investigated by the ^{87}Rb(t,α) reaction with 15-MeV tritons. α-particle spectra were recorded with a semiconductor counter telescope at c.m. angles between 13° and 73°, and excited states were observed up to 4.3 MeV. Differential cross sections for 13 levels were compared with distorted-wave Born-approximation calculations, these comparisons giving l_p values and spectroscopic factors. The predominant $l_p = 1$ and $l_p = 3$ reaction amplitudes, which are assumed to represent $2p_{\frac{3}{2}}$ and $1f_{\frac{5}{2}}$ proton pickup, are essentially exhausted by 4 MeV excitation. All of the experimental angular distributions are best fitted with a single value of l_p, although $l_p = 1$, 3 mixtures would be expected for population of 2^+ levels. One definite $l_p = 4$ angular distribution was observed, this result indicating a small $lg_{\frac{9}{2}}$ proton component in the ^{87}Rb ground state. Results of this experiment are compared with recently reported ^{86}Kr(p,p') and ^{86}Br decay data. (auth)

6497 SPECTRAL ENHANCEMENT OF COBALT NEUTRON CAPTURE GAMMA RAYS. Duffey, D. (Univ. of Maryland, College Park); Wiggins, P. F.; El Kady, A. A. Nucl. Instrum. Methods; 105: No. 1, 23-8(1972).

To determine energy levels and provide information for elemental analysis, particularly of geological materials, the gamma-ray spectra from the capture of neutrons supplied by a pool-type reactor were measured directly with a lithium-drifted germanium, Ge(Li), detector. Cobalt gave a better response than expected from the literature data on neutron absorption and gamma-ray yields. This enhancement stemmed from the signal reinforcement by gamma-ray interactions with the detector and the fortuitous spacing of the energy levels of the excited cobalt nucleus. (4 figures, 2 tables) (auth)

6498 STUDY OF WEAK-COUPLING IN THE ^{87}Kr SYSTEM VIA PROTON DECAY OF ISOBARIC ANALOG RESONANCES IN ^{87}Rb. Hollas, Charles Lawrence. Austin, Tex.; Univ. of Texas (1971). 113p. University Microfilms Order No. 72-19,606.

Thesis.

The ^{87}Kr nuclear system has been investigated in terms of the weak-coupling core-excitation model. The core-excitations in ^{86}Kr were investigated via proton inelastic scattering. Twenty-four levels between 1.55 MeV and 5.07 MeV in excitation have been located. Spins and parities of four levels, 1.55 MeV (2^+), 2.23 MeV (4^+), 2.33 MeV (2^+) and 3.08 MeV (3^-), as well as deformation and coupling parameters have been determined from DWBA and coupled-channel analyses of the inelastic scattering data for protons incident at 14.82 MeV. The wave functions for states in ^{87}Kr have been investigated by studying the proton decay of their isobaric analog resonances in ^{87}Rb. Weak-coupling coefficients for the coupling of single-particle states to the ^{86}Kr ground state core have been determined for fourteen IAR from an analysis of the elastic scattering excitation function data. The inelastic proton decay of three IAR has been investigated to extract weak-coupling coefficients for the coupling of single-particle states to the single-phonon 1.55 MeV (2^+) and 3.08 MeV (3^-) excited core states of ^{86}Kr. The inclusion of these coefficients allows a rather full description of the wave functions of the parent analog states of these IAR. A calculation of the wave functions and binding energies in terms of a simple weak-coupling model was performed for the d- and s-states in ^{87}Kr. Agreement with the experimental results is rather good for the low lying states. (Diss. Abstr. Int., B)

6499 COULOMB EXCITATION OF ^{73}Ge AND QUASIPARTICLE-PHONON COUPLING THEORIES. Salzman, G. C.; Goswami, A.; McDaniels, D. K. (Univ. of Oregon, Eugene). Nucl. Phys., A192: No. 2, 312-28(1972).

The excitation energies and γ-ray decay modes of several low-lying states in the nucleus ^{73}Ge have been studied using Coulomb excitation with 2.6–4.0 MeV α-particles on an enriched ^{73}Ge target to test the predictions of quasiparticle-phonon coupling theories, in particular to test if there are any high-spin states in the low-energy spectrum. Gamma-rays were observed with a 60 cm^3 Ge(Li) detector. Thick-target γ-ray yields were utilized to establish Coulomb excited levels, to clarify the γ-ray decay of ^{73}Ge, and to obtain reduced upward transition probabilities, B(E2)↑, associated with the levels indicated as follows: 68.6 keV (0.073 ± 0.007), 499.0 keV (0.0091 ± 0.0005) and 825.6 keV (0.077 ± 0.004). Angular distributions of the de-excitation γ-rays from the Coulomb excited levels were measured and various spin possibilities for each level were eliminated by the χ^2 technique. The following spin-parity assignments are consistent with the γ-ray angular distribution measurements: 68.6 keV ($\frac{5}{2}^+$, $\frac{7}{2}^+$, $\frac{9}{2}^+$), 499.0 keV ($\frac{7}{2}^+$), and 825.6 ($\frac{7}{2}^+$, $\frac{13}{2}^+$). Branching ratios were extracted from the γ-ray angular distribution measurements. The ϵ B(E2)↑ values for the first 2^+ excited states of ^{72}Ge(0.18), ^{74}Ge(0.29), and ^{76}Ge-(0.27) were also obtained. The results for ^{73}Ge are compared with the predictions of several quasiparticle-phonon coupling theories and some suggestions are made to improve agreement between experiment and theory. (auth)

6500 DESCRIPTION OF DIRECT PROCESS (n,2n) ON SOME NUCLEI. Ezhov, S. N.; Ol'khovskii, V. S. (Kiev State Univ.). Yadern. Fiz.; 16: No. 2, 332-4(Aug 1972). (In Russian).

A type of excitation function of (n,2n) reaction on ^{64}Zn is obtained. Within the framework of the direct knock-out model the comparison with experiment and statistical theory has been conducted. On the

basis of the results obtained the production cross-section for a complex nucleus is calculated proceeding from the dependence on the incident neutron energy. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 5338, 5345, 6446, 6451, 6466, and 6591.

6501 (JINR-P6-6635) QUANTUM CHARACTERISTICS FOR SOME LEVELS OF ^{133}La. Morozov, V. A.; Muminov, T. M.; Fuya, Kh.; Khalikulov, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

The lifetimes of the ^{133}La excited states with energies 97, 130.7; 174 and 724 keV were measured. (auth)

6502 PROBABILITY OF (μ^-,ν) PROCESS ON ^{139}La AND ^{208}Pb NUCLEI. Bunatyan, G. G.; Vil'gel'mova, L.; Evseev, V. S.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 5, 945-8(May 1972). (In Russian).

By the activation method, the relative probabilities of the (μ^-,ν) process on ^{139}La and ^{208}Pb nuclei were determined. The probabilities turned out to be equal to (4 ± 1) and $(9 \pm 1.5)\%$ respectively. These values are compared with the theoretical estimates 5.9% and 10.6% respectively, which were obtained by the finite Fermi system theory methods. (auth)

6503 MEASURING THE LIFETIME OF A COMPOUND NUCLEUS WITH THE SHADOW EFFECT. Kamanin, V. V.; Karamyan, S. A.; Kucher, A. M.; Normuratov, F.; Oganesyan, Yu. Ts. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 2, 252-7(Aug 1972). (In Russian).

An experimental study has been carried out on the problem of influence of the experimental conditions when measuring the lifetime of compound nuclei by the shadow effect method. It is shown that the data remain stable when the monocrystal quality worsens and the thickness of the target layer enlarges. A weak energy dependence of the shadow effect intensity has been confirmed experimentally. The experiments performed exhibit the correctness of the compound nucleus lifetime obtained previously in interactions of tungsten and nuclei with the accelerated heavy ions. (auth)

6504 E1 TRANSITIONS IN ^{108}Ag AND ^{110}Ag. Bondarenko, V. A.; Prokof'ev, P. T.; Rozantsev, I. N.; Estulin, I. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 3, 620-4(Mar 1972). (In Russian).

Gamma radiation spectra released by the ^{107}Ag$(n,\gamma)^{108}$Ag were studied along with internal conversion electrons for this reaction. The electron spectra were measured by a β-spectrograph, and the γ spectra were obtained with a Ge(Li) detector with a 4.8 keV resolution at 661.5 keV energy. The decay scheme was thus expanded in the lower levels, with quantitative assignments to energies and relative intensities of transitions associated with ^{108}Ag. (K.S.W.)

6505 ISOSPIN SPLITTING OF GIANT E1 EXCITATIONS IN THE N = 82 NUCLEUS ^{142}Nd. Hasinoff, M. (Univ. of Washington, Seattle); Fisher, G. A.; Kurjan, P.; Hanna, S. S. Nucl. Phys.; A195: No. 1, 78-90(1972).

The distribution of E1 strength in N = 82 nuclei has been investigated by proton-capture reactions. For ^{142}Nd, the reaction ^{141}Pr$(p,\gamma_0)^{142}$Nd reveals the "usual" Γ, $T_<$ giant resonance at $E_x \approx 15$ MeV with a width of several MeV. Superposed on this resonance are several narrow 1^-, $T_>$ analog resonances, which interfere in a characteristic manner with the broad $T_<$ resonance. As observed for the N = 50 nuclei a major portion of the E1, $T_>$ strength is pushed up into the high-lying resonances. For ^{140}Ce, preliminary observations on ^{139}La$(p,\gamma_0)^{140}$Ce have confirmed the relative weakness of the reaction. (auth)

6506 TWO-PROTON AND PROTON-NEUTRON STATES IN THE DOUBLY CLOSED SHELL $^{132}Sn_{82}$ REGION. Kerek, A.; Holm, G. B.; Borg, S.; De Geer, L.-E. (Research Inst. for Physics, Stockholm). Nucl. Phys.; A195: No. 1, 177-91(1972).

Two states in ^{134}Sb with half-lives of 0.85 ± 0.10 sec and 10.3 ± 0.5 sec have been observed. The two states are ascribed the configurations $(\pi g_{\frac{7}{2}}, \nu f_{\frac{7}{2}})$ with spin assignments 0^- and 7^-, respectively. In the decay of the 10.3 sec (7^-) state two excited 6^+ states in ^{134}Te at 1691.3 and 2397.6 keV are populated. The lower 6^+ state decays by a stretched E2 cascade via a 4^+ state at 1576.1 keV and a 2^+ state at 1279.1 keV to the ground state. The observed states of ^{134}Sb and ^{134}Te are compared to theoretical predictions using a δ-force interaction. (auth)

6507 (p,t) REACTION ON EVEN ISOTOPES OF SAMARIUM. Debenham, Philip Herbert. Minneapolis; Univ. of Minnesota (1971). 79p. University Microfilms Order No. 72-14,410. Thesis.

Even isotopes of Sm have been studied with the (p,t) reaction on the targets ^{148}Sm, ^{150}Sm, ^{152}Sm, and ^{154}Sm at a proton energy 19.00 MeV. Using a split-pole magnetic spectrometer, triton angular distributions were recorded on nuclear track plates. Several final states have been assigned angular momentum and parity J^π on the basis of the angular distributions. The J^π assignments are quite definite for $J^\pi = 0+$ and 3- but are tentative for $J^\pi = 2+$. The (p,t) reaction is observed to populate excited 0+ states in Sm with unusually high intensity, as does the (t,p) reaction. A qualitative explanation is given based on the model of Kumar and Baranger, in which the distinction between spherical and deformed nuclei is softened. In particular, 0+ states at 1.255 MeV in ^{150}Sm and 1.426 MeV in ^{148}Sm that are strongly excited by the (p,t) reaction may be interpreted as "deformed" states in nuclei with "spherical" ground states. Rotational bands built on these 0+ states are identified in the (p,t) spectra. These bands are seen to fit into the systematics of the Sm ground-state bands. (Diss. Abstr. Int., B)

6508 STUDY OF ISOBARIC ANALOG RESONANCES OF THE MOLYBDENUM ISOTOPES EMPLOYING THE $(p,p'\gamma)$ ANGULAR CORRELATION METHOD. Wheeler, Gerald Frank. Stony Brook, N. Y.; State Univ. of New York (1972). 120p. University Microfilms Order No. 72-16,966. Thesis.

The isobaric analog resonances of the ^{93,95,97}Mo ground states in ^{93,95,97}Tc have been investigated by the $(p,p'\gamma)$ angular correlation experiment. Excitation functions were measured in the vicinity of the resonances for the (p,p_0), (p,p') and $(p,p'\gamma)$ reactions. For the $(p,p'\gamma)$ measurements, all possible coincidences between 4 proton detectors and 3 γ-ray detectors were measured for all the excited target states that were populated. The ^{93,95,97}Mo analog states were observed to decay to the first 2^+ state (1.54 MeV) in ^{92}Mo, the 2^+(.871 MeV), 4^+(1.58 MeV), 2^+(1.87 MeV) and 2.08 MeV states in ^{94}Mo and, the 2^+(.778 MeV) state in ^{96}Mo, respectively. The ^{93,95}Mo analog resonances were observed to be symmetric peaks above a background that varies slowly with energy while the ^{97}Mo resonance displayed an asymmetric energy dependence in some of the proton-gamma coincidence pairs. The asymmetry is interpreted as an effect due to the enhancement of the $T_<$ states in the vicinity of the analog state. In the symmetric cases a general procedure is proposed, which takes into account compound nuclear enhancement, to extract relative partial width amplitudes of the analog resonances. Use is made of a new model to explain the enhancement effect in the analysis of the ^{97}Mo asymmetric anomalies. The results of the analysis with these models are discussed. (Diss. Abstr. Int., B)

6509 SYSTEMATIC DISTORTED-WAVE BORN-APPROXIMATION PREDICTIONS FOR TWO-NUCLEON TRANSFERS: APPLICATIONS TO (d,α) EXPERIMENTS. DelVecchio, R. M.; Daehnick, W. W. (Univ. of Pittsburgh). Phys. Rev., C; 6: No. 6, 2095-2108(Dec 1972).

In the case of angular-momentum-mismatch conventional distorted-wave Born-approximation (DWBA) calculations tend to give results which are strongly dependent on the optical-model parameters chosen and, to a lesser degree, on finite-range and nonlocality effects. Reasons for this sensitivity and present systematic calculations for (d,α) reactions on nondeformed targets ranging from ^{48}Ti to ^{208}Pb are discussed. Satisfactory DWBA results could be obtained for the entire range of targets, provided that all potentials for the generation of scattered and bound wave functions were restrained to have nearly identical physically meaningful real well geometries and real depths of $V \approx nV_0$, where V_0 is the proton scattering potential and n is the number of nucleons in the projectile. The use of well geometries with $r_0 = 1.2$ fm, $a = 0.75$ fm and retention of the basic DWBA requirement that the optical potentials should also correctly fit elastic scattering removes the familiar ambiguities for deuteron and α potentials. It is shown that with these parameter restrictions finite-range effects are expected to be small so that a first-order correction procedure is adequate. Explicit calculations are compared with over 30 (d,α) angular distributions of known angular momentum transfer for experimental bombarding energies ranging from 12 to 17 MeV. Consistent agreement with experiment is obtained. (auth)

6510 PROBABILITY OF K-SHELL INTERNAL IONIZATION IN THE BETA DECAY OF ^{99}Tc. Watson, R. L.; Chulick, E. T.; Howard, R. W. (Texas A and M Univ., College Station). Phys. Rev., C; 6: No. 6, 2189-93(Dec 1972).

The K-shell internal ionization probability for the decay of

^{99}Tc was measured using a high-resolution Si(Li) x-ray spectrometer. Absolute source strengths were determined on the basis of source weight and also from an analysis of the intensities of Tc K x rays produced during irradiations with 60-MeV α particles. A value of $(3.89 \pm 0.16) \times 10^{-4}$ per β decay was obtained for the K-shell internal-ionization probability. This result is compared with the predictions of various theories of electron shakeoff. (auth)

6511 NUCLEAR ORIENTATION STUDY OF THE DECAYS OF $^{126\ 127\ 128}$Sb. Krane, K. S.; Steyert, W. E. (Los Alamos Scientific Lab., NM). Phys. Rev., C; 6: No. 6, 2268-75(Dec 1972).

Angular distributions were measured for a number of γ rays emitted by ^{126,127,128}Sb polarized at low temperatures in iron. From the 0–90° anisotropies of the angular distributions, with the proposed spin values J = 8 (^{126,128}Sb) and J = 7/2 (^{127}Sb), the ground-state magnetic moments were deduced to be $|\mu(^{126}\text{Sb})| = 1.28 \pm 0.07\ \mu_N$, $|\mu(^{127}\text{Sb})| = 2.59 \pm 0.12\ \mu_N$, and $|\mu(^{128}\text{Sb})| = 1.31 \pm 0.19\ \mu_N$. Based on the anisotropies of the ^{127}Te γ rays, the following ^{127}Te spin assignments are favored (level energies in keV): $3/2^+$ (0), $1/2^+$ (61), $11/2^-$ (88), $9/2^-$ (341), $5/2^+$ (473), $7/2^-$ (632), $7/2^+$ (686), $5/2^+$ (784), $9/2^-$ (786), $7/2^+$ (924), $5/2^+$ or $9/2^+$ (1077), $5/2^+$ (1142), $5/2^+$ (1290). Based on these spin assignments, E2/M1 mixing ratios were deduced for a number of ^{127}Te γ rays. (auth)

6512 PROTON EXCITATIONS IN $^{108\ 110}$Cd FROM (^{3}He,d) REACTIONS. Auble, R. L.; Horen, D. J.; Bertrand, F. E.; Ball, J. B. (Oak Ridge National Lab., TN). Phys. Rev., C; 6: No. 6, 2223-31(Dec 1972).

The nuclear energy levels of ^{108,110}Cd up to 4 MeV of excitation are examined by the ^{107,109}Ag(^{3}He,d) reactions. Approximately 30 levels are populated in each nucleus, many of which were previously unreported. l values and spectroscopic strengths are given for the more strongly excited states. The data are compared with previously reported levels and J^π assignments, and are used to resolve several discrepancies in reported ^{110m}In decay schemes. (auth)

6513 ANALYSIS OF ANALOG RESONANCES IN ^{115}In(p,p) ^{115}In BETWEEN 6.6 AND 7.6 MeV. Chen, Cary; Adams, J. L. (Ohio Univ., Athens). Phys. Rev., C; 6: No. 6, 2237-44(Dec 1972).

The ^{115}In(p,p)^{115}In reaction for E_p = 6.6 to 7.6 MeV was analyzed. The target spin of ^{115}In is $9/2^+$. This means that there can be a maximum of 10 partial waves in each analog resonance. However, there are usually one or two dominant single-particle states which contribute to a resonance. In this reaction the $s_{1/2}$ and $d_{3/2}$ channels are dominant in the energy region from 6.6 to 7.6 MeV. Fits to the differential cross-section data of Thompson, et al., were found to be quite good when only these two channels were included for the positive-parity states. The $s_{1/2}$ and $d_{3/2}$ channels can couple to the $9/2^+$ target spin to give total spins and parities of 4^+, 5^+, and 3^+, 4^+, 5^+, 6^+. All of these states were seen and analyzed. A sum rule is derived which involves the total spins of the resonances. The total spins assigned are found to be consistent with this sum rule. There is a strong amount of mixing in the 4^+ and 5^+ states. (auth)

6514 SEARCH FOR NUCLEAR ISOMERIC STATES BY GAMMA-RAY STUDIES. Arimilli, P. A. Minneapolis; Univ. of Minnesota (1972). 112p. University Microfilms Order No. 72-27,722.

Thesis.

The pulsed beam facilities of the proton Linear Accelerator and the MP-2 Tandem Van de Graaff generator of the University of Minnesota have been used to investigate the isomeric states produced by a variety of nuclear reactions. Recently developed high resolution lithium drifted germanium detectors have been used to detect the gamma rays. This has enabled the measurement of the energy of the K_α component of the isomeric x-ray with sufficient accuracy to identify the atomic number of the isomeric nucleus. The present work is concerned with isomeric states which decay with half-lives in the range 10^{-5} sec to 10^{-2} sec. Gamma ray spectra have been recorded at suitable time intervals following beam bursts. The half-life of the isomeric state has been determined from the record of the spectra taken at these time intervals. First, a survey has been made using all the available targets. When a new isomeric state is found, the reaction is identified, if possible, by measuring the excitation function using the variable energy provision of the Tandem Van de Graaff generator. With 40 MeV proton beam from the Linac on targets of Pd, Cs, La, Ce, Yb and Re, nine new isomers, with half-lives in the quoted range, were observed. Moreover, the measured energies and half-lives of the isomeric transitions obtained with Te and Er targets, were in good agreement with the previously reported values. Further measurements using the Tandem enabled the isomeric activity of the Te and Er targets to be assigned to ^{122}I and ^{165}Tm respectively. This assignment to ^{122}I is in contradiction with the previously reported assignment to ^{121}I. The isomeric transition in ^{165}Tm was deduced to be E2 in character as opposed to the earlier assignment of E1 for this transition. The isomeric state in ^{165}Tm is explained in terms of the K- selection rule. (Diss. Abstr. Int., B)

6515 EXCITATION FUNCTIONS FOR THE PRODUCTION OF ^{90}Nb AND ^{88}Y BY IRRADIATION OF ZIRCONIUM WITH DEUTERONS. Mercader, R. C.; Caracoche, M. C.; Mocoroa, A. B. (Univ. Nacional, La Plata). Z. Phys.; 255: No. 2, 103-11(1972).

Excitation functions for reactions induced by deuterons on natural zirconium and ^{90}Zr targets have been measured radiochemically with the stacked foil technique between ≈9 and 27 MeV. The observed reactions are Zr(d,xn)^{90}Nb, Zr(d,αxn)^{88}Y, ^{90}Zr(d,2n)^{90}Nb and ^{90}Zr(d,α)^{88}Y. The excitation functions for the reactions ^{91}Zr(d,3n)^{90}Nb and ^{91}Zr(d,α)^{88}Y have been deduced from the results mentioned above. Calculations of the excitation function for the (d,2n) reaction have been performed with two different treatments, each one taking into account two competitive mechanisms. The compound-statistical model plus Hittmair's stripping theory accounts quite well for the (d,2n) cross sections observed. However, the agreement obtained with Peaslee–Otozai's theory is excellent and the set of parameters used more reasonable. It has been assumed that the stripping mechanism can have no contribution to the (d,α) reaction. Accordingly, calculations for this reaction have been done using the compound-statistical model and the entire absorption process followed by the evaporation of an α particle. No good agreement is obtained with either theory. (auth)

6516 LEVEL STRUCTURE OF ^{90}Mo VIA THE ^{92}Mo(p,t) ^{90}Mo REACTION. Youngblood, D. H.; Kozub, R. L. (Texas A and M Univ., College Station). Nucl. Phys., A192: No. 2, 442-8(1972).

Twenty-two levels in ^{90}Mo were identified using the (p,t) reaction on ^{92}Mo at 39 MeV bombarding energy. Angular distributions were obtained for 12 levels and are compared with distorted-wave Born approximation calculations. Definite spin-parity assignments were made for five previously unassigned levels. Only one very weak 0^+ excited state was observed. The results are compared to similar studies of ^{84}Kr and ^{88}Zr. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 6456, 6507, 6509, and 6514.

6517 (JINR–P6-6649) NEW DATA ON THE DECAY ^{169}Lu → ^{169}Yb. Bonch–Osmolovskaya, N. A.; Gromov, K. Ya.; Islamov, T. A.; Khamidov, A. Sh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

The spectra of gamma-rays and conversion electrons from ^{169}Lu decay have been measured with more developed experimental techniques than those previously used. On the basis of all the data obtained the level scheme of ^{169}Yb is analyzed. The investigation of ^{169}Yb excited state properties is carried out and some conclusions on a possible nature of particular states are drawn. (auth)

6518 STATES IN ^{174}Lu POPULATED BY SINGLE-PARTICLE TRANSFER REACTIONS. O'Neil, R. A.; Burke, D. G. (McMaster Univ., Hamilton, Ont.). Nucl. Phys.; A195: No. 1, 207-40(1972).

The nuclear structure of the doubly odd nucleus ^{174}Lu has been investigated using the following four single-particle transfer reactions: ^{173}Yb(α,t)^{174}Lu, ^{173}Yb(^{3}He,d)^{174}Lu, ^{175}Lu(^{3}He,α)^{174}Lu and ^{175}Lu(d,t)^{174}Lu. Beams of 24 MeV ^{3}He particles, 28.5 MeV α-particles and 12 MeV deuterons were used. The reaction products have analyzed in an Enge split-pole magnetic spectrograph. The proton transfer data have enabled the assignment of the $1/2^-$[541], $5/2^+$[402], $9/2^-$[514] and the $1/2^-$[530] proton orbitals coupled to the $5/2^-$[512] neutron in both spin triplet and singlet configurations. Strong Coriolis coupling has been observed in bands formed by the transfer of the $1/2^-$[541] and the $1/2^-$[530] protons. The neutron-transfer data have been used to confirm previous assignments of the $5/2^-$[512], $1/2^-$[521] and $3/2^-$[521] neutron orbitals coupled to the $7/2^+$[404] proton. The observation of levels populated by high-l transfers in the (^{3}He,α) reaction has led to a revised assignment of the $K^\pi = 7^+$, $\{7/2^+[633]_n + 7/2^+[404]_p\}$ rotational band. Similarly the spin-triplet $K^\pi = 0^+$ configuration of these two orbitals has also been identified. (auth)

6519 DE-EXCITATION OF THE $1/2^-$[541] AND [411] BANDS IN ^{177}Lu. Manfrass, P.; Andrejtscheff, W. (Zentralinstitut fuer

Kernforschung Rossendorf, Dresden). Nucl. Phys.; A194: No. 3, 561-72(1972). (In German).

The decay and the structure of the $1/2^-[541]$ and $1/2^+[411]$ bands in ^{177}Lu have been studied in the (n,γ) reaction by means of prompt and delayed γ-γ coincidence measurements. Nanosecond lifetime investigations with Ge(Li) detectors provided the following results for the ^{177}Lu excited levels: $T_½$(761.6 keV, $5/2\ 1/2^-[541]$) = 35 ± 5 ns; $T_½$(573.6 keV, $3/2\ 1/2^+[411]$) = 3.5 ± 1 ns; T (457.9 keV, $5/2\ 5/2^+[402]$) ≦ 0.8 ns. The structure of the $1/2^-[541]$ band and the decay of the 35 ns isomer $5/2\ 1/2^-[541]$ to the $1/2^+[411]$, $5/2^+[402]$ and $7/2^+[404]$ bands are discussed in terms of the Nilsson theory by taking into consideration pairing correlations and the rotation-particle coupling (RPC). (auth)

6520 STUDY OF POSITIVE-PARITY STATES IN ^{165}Er, ^{167}Er, AND ^{169}Er WITH THE (^{3}He,α) REACTION. Loevhoeiden, G. (Univ. of Oslo); Tjoem, P. O.; Edvardson, L. O. Nucl. Phys.; A194: No. 3, 463-80(1972).

Levels in ^{165}Er, ^{167}Er, and ^{169}Er have been studied by means of the (^{3}He,α) reaction with 25.5-MeV ^{3}He particles. The l-values were determined by comparing (^{3}He,α) and (d,t) cross sections. Only one strongly populated $13/2^+$ state was observed in ^{165}Er, while two about equally strong $13/2^+$ states were identified in the other two nuclei. This is readily explained by the strong Coriolis coupling between the N = 6 ($i_{13/2}$) Nilsson orbitals. (auth)

6521 LIFETIMES OF LEVELS IN ^{152}Sm. El-Aasser, M. R.; Badawy, O. E.; Awwad, Z.; El-Farrash, A. H. (Atomic Energy Establishment, Cairo). Z. Naturforsch.; 27a: No. 8-9, 1229-32 (1972).

The half-lives of the 121.78 and 366.5 keV levels in ^{152}Sm were measured by a delayed coincidence technique. The values (1.35 ± 0.05) ns and (42 ± 18) ps were found, respectively. Transition probabilities and nuclear deformation parameters were deduced. (auth)

6522 DECAY OF ^{169}Yb. Sen, S. K. (Univ. of Manitoba, Winnipeg); Salie, D. L.; Tomchuk, E. Can. J. Phys.; 50: No. 19, 2348-54(1 Oct 1972).

The decay of ^{169}Yb was investigated using several Ge(Li) detectors of different sizes. The following gamma rays (energies in keV and intensities within brackets) were definitely identified with the ^{169}Yb decay: 20.7 (0.66 ± 0.04), 63.1 (124 ± 5), 93.6 (7.2 ± 0.3), 109.8 (50 ± 2), 117.3 (0.08 ± 0.04), 118.2 (5.4 ± 0.2), 130.5 (34 ± 2), 156.7 (0.023 ± 0.004), 177.2 (59 ± 3), 198.0 (100), 240.4 (0.33 ± 0.02), 261.0 (4.7 ± 0.2), and 307.7 (28 ± 1). The recently reported weak gamma-ray peaks at 515 (0.008 ± 0.002) and 625 (0.010 ± 0.002) were also observed and could not be ruled out as not belonging to ^{169}Yb. The recently reported gamma-ray peaks at 140, 160, 207, 288, 295, 316, 320, 328, 355, 371, 379, 396, and 417 were detected and shown not to be from the decay of ^{169}Yb while those at 218, 229, 285, 304, 335, 388, 411, and 425 were not observed and upper limits were placed on their intensities. The presence of very weak peaks at 515 and 625 establishes the formation of the 633 keV state of ^{169}Tm following electron capture decay of ^{169}Yb as reported by George. (This level was previously observed only in Coulomb excitation of ^{169}Tm.) The total internal conversion coefficient for the 20.7 keV transition was determined for the first time from the direct measurement of the gamma-ray intensity as 51 ± 10 corresponding to an M1 transition. (auth) (Canada)

6523 DECAY OF THE FIVE-QUASIPARTICLE ISOMERIC STATES IN ^{177}Hf. Chu, Y. Y.; Haustein, P. E.; Ward, T. E. (Brookhaven National Lab., Upton, NY). Phys. Rev., C; 6: No. 6, 2259-68(Dec 1972).

The decay of 51.4-min ^{177m_1}Hf was studied in detail by means of Ge(Li) detectors and a Si(Li) detector. The L-subshell conversion-electron ratios for the 214.0-keV isomeric transition were measured with a double-focusing β-ray spectrometer. An E3 multipolarity was deduced for the isomeric transition, and thus a spin–parity of $I^\pi = 37/2^-$ was established for the isomeric state. Coincidence measurements identify the $K^\pi = 23/2^+$ rotational band up to the $I = 31/2$ member. The rotational-model quantity $(g_K - g_R)^2/Q_0^2$, derived from the γ-ray intensities of the cascade and crossover transitions, was used to deduce the gyromagnetic ratios for this band. (auth)

6524 MAGNETIC DIPOLE MOMENTS OF FIRST 2^+ STATES IN EVEN OSMIUM NUCLEI RECOIL-IMPLANTED IN NICKEL. Sioshansi, P.; Garber, D. A.; Grabowski, Z. W.; (and others) (Purdue Univ., Lafayette, IN). Phys. Rev., C; 6: No. 6, 2245-52(Dec 1972).

The ion-implantation–perturbed-angular-correlation technique was used to measure the g factors of the first 2^+ excited states of four even osmium nuclei in a ferromagnetic nickel host. The observed angular precessions were: $\omega\tau(^{192}Os) = 0.22 \pm 0.01$, $\omega\tau(^{190}Os) = 0.277 \pm 0.009$, $\omega\tau(^{188}Os) = 0.39 \pm 0.03$, and $\omega\tau(^{186}Os) = 0.38 \pm 0.08$. The angular precession result for ^{192}Os is in excellent agreement with the results of perturbed-angular-correlation measurements in nickel using radioactive sources. It was found that the internal field seen by the osmium nuclei implanted in nickel is in good agreement with the value obtained by room temperature NMR techniques. The available direct lifetime measurements for ^{186,188}Os and lifetimes extracted from B(E2) values for ^{190,192}Os are used to obtain the gyromagnetic ratios: $g(^{192}Os) = 0.39 \pm 0.03$, $g(^{190}Os) = 0.39 \pm 0.03$, $g(^{188}Os) = 0.29 \pm 0.03$, and $g(^{186}Os) = 0.24 \pm 0.05$. (auth)

6525 PHOTONUCLEAR QUADRUPOLE RESONANCE IN ^{160}Gd. Dreyer, F.; Dahmen, H.; Staude, J.; Thies, H. H. (Univ., Heidelberg). Nucl. Phys., A192: No. 2, 433-41(1972).

The (γ,n) and (γ,p) cross sections in ^{160}Gd were measured from threshold to 33 MeV using bremsstrahlung from a 33 MeV betatron and observing the induced activities. Both cross sections contain a broad maximum at 23.5 MeV. It is argued that this maximum is the quadrupole resonance predicted at 1.6 times the E1 giant-resonance energy by the hydrodynamic model. (auth)

6526 CAPTURE RESONANCE PARAMETERS OF ^{169}Tm. Arbo, J. C.; Felvinci, J. P.; Havens, W. W. Jr.; (and others) (Columbia Univ., New York). Trans. Amer. Nucl. Soc.; 15: No. 2, 943-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 6451, 6488, 6502, 6509, and 6524.

6527 ^{210}Po FISSION IN ^{206}Pb(α,f) REACTION. Itkis, M. G.; Kuvatov, K. G.; Okolovich, V. N.; (and others) (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz.; 16: No.2, 258-70(Aug 1972). (In Russian).

The integral and differential cross sections for ^{206}Pb(α,f) fission have been measured for the α-particle energy range 29 to 46 MeV. The analysis of the experimental data provides the value of the height of the fission barrier $E_f = 19.2 \pm 0.8$ MeV, critical energies of the phase transition from a superfluid state of ^{210}Po fissioning nucleus to the normal one $E^*_{cr} = 10.0^{+2.5}_{-1.6}$ MeV, and correlation functions in the basic state $\Delta_0^f = 0.9$ MeV. The data on E^*_{cr} and Δ_0^f are in contradiction with the hypothesis on the anomalous value of the energy gap $2\Delta_0^f \sim 4$ MeV in the spectra of the transition state of ^{210}Po. From the magnitude E_f an estimation of the parameter $(Z^2/A)_{cr} = 45$ of the liquid drop model with smeared nucleus edge is given. The influence of the coupling effects of nucleons and nucleonic shells on the nucleonic density level is discussed. (auth)

6528 ANGULAR DISTRIBUTION OF NEUTRONS DURING THE INTERACTION OF HEAVY IONS WITH NUCLEI OF ^{197}Au, ^{209}Bi, AND ^{238}U. Karamyan, S. A.; Sharifov, K. N.; Gafurov, V. G.; Oganesyan, Yu. Ts. (Tadzhik State Univ., Stalinabad, USSR). Dokl. Akad. Nauk Tadzh. SSR; 15: No. 8, 21-4(1972). (In Russian).

The angular distribution of fission products and neutrons released during bombardment of the nuclei ^{197}Au, ^{209}Bi, and ^{238}U by accelerated ions of ^{40}Ar, ^{22}Ne, ^{16}O, and ^{12}C was studied. A 300 μg/cm² layer of ^{237}Np was used as a neutron detector, and was positioned around the target to catch neutrons between the angles of 15 and 165°. Fission fragments were recorded by silicate glasses also positioned near the target. (K.S.W.)

6529 HIGH RESOLUTION GAMMA-SPECTRUM IN THE DECAY OF ^{192}Ir. Sen, S.; Sinha, B. K.; Bhattacharyya, R. (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys.; 45: No. 11, 499-503(Nov 1971).

The gamma-ray spectrum following the decay of ^{192}Ir has been measured with a high resolution (2.6 keV) Ge(Li) detector. Measured energies and relative intensities of the 16 gamma-rays are: 210 keV (0.70); 206 keV (4.8); 296 keV (37.0); 308.5 keV (35.3); 316.5 keV (100); 374 keV (0.70); 414 keV (0.80); 468 keV (64.1); 485 keV (4.3); 489 keV (0.60); 589 keV (5.6); 604.5 keV (11.3); 612.5 keV (7.2); 628 keV (0.40); 886 keV (0.50); 1062 keV (0.10). K-shell internal conversion coefficients for these gamma-rays have been deduced from the gamma-ray intensities obtained from the present measurement and the conversion electron intensities from the high-resolution IEC measurements of Schellenberg & Kern (1966). A modified decay scheme of ^{192}Ir is proposed on the

basis of the present measurement and also compared with recent theoretical calculations. (auth)

6530 INELASTIC SCATTERING OF ^{16}O FROM ^{208}Pb. Becchetti, F. D.; Kovar, D. G.; Harvey, B. G.; (and others) (Univ. of California, Berkeley). Phys. Rev., C; 6: No. 6, 2215-18(Dec 1972).

The inelastic scattering of ^{16}O from ^{208}Pb was studied at an incident ^{16}O energy of 104 MeV. The angular distributions to the 3^-, 5^-, and 2^+ levels at 2.62, 3.20, and 4.10 MeV in ^{208}Pb show interference patterns like those expected from the destructive interference of Coulomb and nuclear excitation. The phase, α, of the nuclear excitation form factor is determined to be $\alpha = 30 \pm 15°$, in good agreement with the collective model. Transition probabilities deduced from the potential deformations are smaller by a factor of ~ 2 than the electromagnetic transition probabilities measured in (e,e') or Coulomb excitation. (auth)

6531 DOUBLE INTERNAL BREMSSTRAHLUNG IN THE BETA DECAY OF ^{204}Tl. Bond, A.; Lancman, H. (Brooklyn Coll.). Phys. Rev., C; 6: No. 6, 2231-6(Dec 1972).

Double intern. remsstrahlung was observed in the β decay of ^{204}Tl for photon energies above 103 keV. Coincident photons, detected by two 3-in. × 3-in. NaI(Tl) detectors located at an angle of 90°, form a two-dimensional spectrum. Total intensities are obtained as a function of the sum of the energies deposited in the two detectors. The ratio of the intensity of the double internal bremsstrahlung for a sum energy, E, to the intensity of the single internal bremsstrahlung for a photon of energy E associated with this decay was found as a function of E. The experimental results are compared with theoretical calculations. (auth)

6532 NUCLEAR SPECTROSCOPY OF ^{205}Pb. Ahluwalia, B. D. Boston; Boston Univ. (1972). 173p. University Microfilms Order No. 72-25,236.

Thesis.

Gamma–gamma directional correlations in the decay of 15.3 day ^{205}Bi were undertaken employing a lithium drifted germanium gamma detector of 35 cc volume for one radiation, and a 5 × 5 cm NaI(Tl) detector for the other radiation. For the first time, the correlation coefficients were used to establish the spin-parities of ten states in lead 205, and multipolarity mixing ratios of thirteen gamma transitions were deduced. The error limits on mixing ratios are much lower than those obtained from internal conversion results. The experimental results on spin-parity assignments, and the multipolarities are interpreted in terms of the reported shell-model calculations. In order to remove the disagreement between the reported internal field values at lead 207 nuclei in an iron host, time-integrated perturbed angular correlation measurements were made on the 1060-570 keV cascade in ^{207}Pb. Two 5 × 5 cm NaI(Tl) detectors were employed in conjunction with standard slow-fast coincidence circuitry. The results give a value of (595 ± 54) kilogauss as the internal field at lead nuclei in an iron host. Perturbed angular correlation measurements were also made on the (1862 + 1903)-703 keV cascade in ^{205}Pb. Using (623 ± 27) kilogauss, as a weighted mean value of the reported results of the internal field at lead, W = (62 ± 22) milliradians, for the 703 keV state in ^{205}Pb, a result which does not agree with the simple model of a particle or hole coupled to the excited state of an even–even neighboring core. (Diss. Abstr. Int., B)

6533 NUCLEAR REACTIONS INDUCED BY ^{12}C AND ^{16}O ON ^{205}Tl AND ^{209}Bi; ^{214}Fr ISOMERIC RATIO; COMPOUND NUCLEUS; AND ^{8}Be TRANSFER PROCESS. Le Beyec, Y.; Lefort, M.; Sarda, M. (Institut Physique Nucleaire, Orsay, France). Nucl. Phys., A192: No. 2, 405-16(1972).

Targets of ^{205}Tl have been bombarded by ^{12}C (60–90 MeV) and by ^{16}O (60–100 MeV), and ^{209}Bi has been bombarded by ^{12}C (60–90 MeV). Excitation functions were determined for ^{211}Fr, ^{212}Fr, ^{213}Fr and for the two isomers ^{214}Fr. Since ^{214m}Fr cannot be produced as a daughter of ^{218}Ac, it was possible to study the de-excitation of ^{221}Ac into ^{218}Ac by the measurement of ^{214f}Fr. Inversely, ^{214m}Fr is a prompt product of nuclear reactions. The thresholds of the reactions have been determined and correspond to low Coulomb barriers ($r_0 = 1.52$ fm for ^{12}C and 1.45 fm for ^{16}O). The effect of high angular momenta on the feeding of the isomeric state, ^{214m}Fr ($9\hbar$), in the reaction $^{205}Tl(C,3n)^{214}Fr$ has been clearly demonstrated. The results on the excitation function of ^{214m}Fr in the high-energy region show that a partial fusion nucleus is formed after the transfer of a ^{8}Be cluster ($^{209}Bi + {}^{8}Be$). (auth)

6534 LOW-ENERGY PROTON PRODUCTION UNDER 600-MeV PROTON BOMBARDMENT. Orr, H. D. (Langely Research Center, Hampton, Va.); Edge, R. D.; Fillippas, T. A. Trans. Amer. Nucl. Soc.; 15: No. 2, 972(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 6451, 6528, 6802, 6864, and 6866.

6535 SEARCH FOR SUPERHEAVY ELEMENTS IN NATURE. Cheifetz, E.; Jared, R. C.; Giusti, E. R.; Thompson, S. G. (Univ. of California, Berkeley). Phys. Rev., C.; 6: No. 4, 1348-61(Oct 1972).

The results of a search for elements in the region of atomic number 114 are reported. More than 40 large samples of ores, natural minerals, and other possible sources were investigated. The method of detection made use of a large liquid scintillator to detect spontaneous fission events in which unusually large numbers of neutrons are emitted. The apparatus was located in a tunnel under about 250 m of earth shielding in order to reduce the interfering effects of cosmic rays. The limit set for the ratio of half-life/concentration for all the materials tested was greater than 10^{23} yr/concentration. If the half-life were 10^9 yr, this limit would correspond to a concentration of less than 10^{-14} moles of superheavy elements per mole of sample. (7 figures, 4 tables, 29 references) (auth)

6536 PRODUCTION OF GOLD ISOTOPES IN BOMBARDING ^{238}U WITH ^{136}Xe IONS. Oganesyan, Yu. Ts.; Orlova, O. A.; Penionzhkevich, Yu. E.; Gavrilov, K. A.; Kim De Yen (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 2, 249-51(Aug 1972). (In Russian).

The cross sections for production of $^{194,196,196m,198,199}Au$ in the interaction of ^{136}Xe ions with ^{238}U have been measured. The cross sections obtained are from 0.12 up to 0.32 mb. The results are compared with the calculations made in assumption on fission of 146^{378} compound nucleus. The possibility of exploiting the fission mechanism for production of heavier elements up to Z = 110–114 is being discussed. (auth)

6537 MEASURING THE EXCITATION ENERGY OF SPONTANEOUSLY FISSIONING ISOMER $^{239}Pu(\gamma,n)$. Gangrskii, Yu. P.; Markov, B. N.; Kharisov, I. F.; Tsipenyuk, Yu. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 2, 271-6(Aug 1972). (In Russian).

The excitation function of the reaction $^{240}Pu(\gamma,n)$, that leads to production of spontaneously fissioning isomer ^{239}Pu with a half-life at 8.5 sec has been measured. The excitation function measured is analyzed in different assumptions on the reaction mechanism. It is shown, that the threshold value for the reaction obtained from the analysis, and consequently, the excitation energy of spontaneously fissioning isomer, differ greatly from the assumption on the reaction mechanism. (auth)

6538 EMISSION OF LONG-RANGE α-PARTICLES IN THE SUBTHERMAL-, THERMAL-, AND RESONANCE-NEUTRON FISSION OF ^{239}Pu. Schroeder, Ivan G. (National Bureau of Standards, Washington, D. C.). Nucl. Phys.; A195: No. 1, 257-68 (1972).

An investigation has been made of the possible dependence of the binary-to-ternary fission ratio as well as of the energy distribution of the long-range α-particles emitted in the low-energy fission of ^{239}Pu on the energy of the incident neutron. To this effect a number of relative measurements have been made using three neutron filters covering, respectively, the subthermal-, thermal- and resonance-neutron regions. Furthermore, a measurement of the binary-to-ternary fission ratio has been performed for a reactor beam. The results obtained show no variation in the binary-to-ternary fission ratio or in the energy of the long-range α-particles for the energy intervals considered to within the precision of these measurements. The measurement with the reactor beam yielded a value of the binary-to-ternary fission ratio of 412 ± 11. (auth)

6539 CALORIMETRIC MEASUREMENT OF ALPHA HALF-LIFE OF ^{244}Cm. Kerrigan, W. J.; Dorsett, R. S. (E. I. Du Pont de Nemours and Co., Aiken, SC). J. Inorg. Nucl. Chem.; 34: No. 12, 3603-6(Dec 1972).

The alpha half-life of ^{244}Cm was measured by calorimetric determination of the change in power of a curium oxide source over a period of 743 days and was found to be 18.13 ± 0.04 yr. A recommended value of 18.12 ± 0.06 (P = 0.95) yr is derived by combining this result with the previously accepted value of 18.099 ± 0.015 (P = 0.67) yr. (auth)

6540 SPONTANEOUS FISSION HALF-LIFE OF ^{244}Cm. Hastings, J. D.; Strohm, W. W. (Monsanto Research Corp., Miamisburg, OH). J. Inorg. Nucl. Chem.; 34: No. 12, 3597-3602(Dec 1972).

The spontaneous fission half-life of ^{244}Cm has been measured and found to be $(1.343 \pm 0.006) \times 10^7$ yr. The spontaneous fission fragments and alpha particles were counted with a silicon surface barrier detector, and the spontaneous fission half-life was calculated by comparing the alpha-to-fission ratio with the ^{244}Cm alpha half-life of 18.099 yr. (auth)

6541 TRITIUM AND ALPHA-PARTICLE YIELDS IN FAST AND THERMAL NEUTRON FISSION OF ^{235}U. Fluss, M. J.; Dudey, N. D.; Malewicki, R. L. (Argonne National Lab., IL). Phys. Rev., C; 6: No. 6, 2252-9(Dec 1972).

The tritium yields per fission for ^{236}U are reported for the reaction ^{235}U + n from thermal energies to 700 keV. In addition, the corresponding α-particle yields and energy spectra are reported above neutron energies of 170 keV. An increase of a factor of 2.3 to 2.4 in the tritium yield over its thermal value of $0.85 \pm 0.09 \times 10^{-4}$ tritons per fission is observed. No similar change is observed for the α-particle yields. (auth)

6542 DISTRIBUTION OF MASS AND CHARGE IN THE SPONTANEOUS FISSION OF ^{244}Cm. Flynn, K. F.; Srinivasan, B.; Manuel, O. K.; Glendenin, L. E. (Argonne National Lab., IL). Phys. Rev., C; 6: No. 6, 2211-14(Dec 1972).

The distribution of mass and charge in the spontaneous fission of ^{244}Cm was investigated by radiochemical and mass spectrometric determination of the fission yields for 40 mass chains and 2 shielded nuclides (independent yields). The mass distribution is highly asymmetric with a relative probability of asymmetric-to-symmetric fission (peak-to-valley ratio) of greater than 5700. The average masses of the light and heavy groups are 103.1 and 138.7. The characteristics of the mass distribution, as well as the division of nuclear charge indicated by the independent yields of the two shielded nuclides, are consistent with the systematics established from other studies of low-energy fission. (auth)

6543 MULTIPOLARITY DETERMINATION FROM L X-RAY SPECTRA IN THE DECAYS OF ^{227}Th, ^{243}Am, AND ^{249}Cf. Schmidt-Ott, W.-D.; McGeorge, J. C.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Z. Phys.; 255: No. 2, 161-74(1972).

A new method to determine the multipolarity of a converted γ-transition from its L x-ray spectrum has been extended by a coincidence technique and applied in the complex decays of ^{227}Th, ^{243}Am, and ^{249}Cf. The L x-ray spectra of four low energy transitions have been measured in coincidence with cascading high energy γ-rays and their M1−E2 mixing ratios obtained by comparison with calculated L x-ray line intensities. The following results were obtained: for the $^3/_2^+ \rightarrow {}^1/_2^+$ ground-state transition in ^{223}Ra, an admixture of (74 ± 12)% E2, for the $^7/_2^+ \rightarrow {}^5/_2^+$ ground-state transition in ^{239}Np, less than 30% E2, for the $^9/_2^+ \rightarrow {}^7/_2^+$ ground-state transition in ^{245}Cm, (63 ± 10)% E2, and for the $^{11}/_2^- \rightarrow {}^9/_2^-$ transition in the third rotational band in ^{245}Cm, (32 ± 10)% E2. (auth)

6544 SPECTRUM MEASUREMENTS IN A DEPLETED URANIUM METAL BLOCK FOR INVESTIGATION OF DISCREPANT ^{238}U CROSS SECTIONS. Bluhm, H. (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 2, 898-9 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6545 DELAYED-NEUTRON ENERGY SPECTRA. Sloan, W. R.; Woodruff, G. L. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 15: No. 2, 942-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6546 RESONANCE PARAMETERS IN THE LOW-ENERGY NEUTRON-INDUCED FISSION OF ^{233}U AND ^{235}U. Felvinci, J. P.; Melkonian, E. (Columbia Univ., New York). Trans. Amer. Nucl. Soc.; 15: No. 2, 944-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6547 MEASUREMENT OF ^{235}U AND ^{238}U FISSION CROSS SECTIONS FOR ^{252}Cf SPONTANEOUS FISSION NEUTRONS. Grundl, J. A.; Spiegel, V. Jr.; Eisenhauer, C. (National Bureau of Standards, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 945-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6548 ABSOLUTE DETERMINATION OF THE ^{235}U FISSION CROSS SECTION at 964 keV. Gilliam, D. M.; Knoll, G. F. (Univ. of Michigan, Ann Arbor). Trans. Amer. Nucl. Soc.; 15: No. 2, 946(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Nuclear Theory

Refer also to abstracts 5136, 6097, 6104, 6461, 6490, and 6500.

6549 (COO-3001-20) THREE-BODY FORCES. Brown, G. E. (State Univ. of New York, Stony Brook. Inst. for Theoretical Physics. Nordisk Institut for Teoretisk Atomfysik, Copenhagen (Denmark)). 1972. Contract AT(11-1)-3001. 8p. (CONF-720819-14). Dep. NTIS.

From International conference on few particle problems in nuclear interactions; Los Angeles, CA, (28 Aug 1972).

The possible mechanisms of the three-body force are examined. Possible ways of combining mechanisms are discussed. Progress in the evaluation of three-body interactions with good wave functions is evaluated. (J.W.R.)

6550 (COO-3001-23) RPA CALCULATION OF THE EFFECTIVE CHARGE IN A HARTREE-FOCK BASIS. Ellis, P. J. (Oxford Univ. (England). Nuclear Physics Lab. Oslo Univ. (Norway). Fysisk Institutt); Osnes, E. (Oslo Univ. (Norway). Fysisk Institutt. State Univ. of New York, Stony Brook. Dept. of Physics). 1971. Contract AT(11-1)-3001. 16p. Dep. NTIS.

Using a Hartree−Fock basis the diagrams of the Tamm−Dancoff and random-phase approximations have been summed to calculate the effective charge in the (1s0d) shell. The enhancement of the effective charge found by this summation is much less than in an oscillator basis, in fact in most cases the HF RPA result is smaller than the value obtained from the lowest order core polarization diagram in an oscillator basis. The HF neutron effective charges are thus too small. For protons the enhancement of the bare effective charge in a HF basis must also be taken into account, but for cases involving the $0d_{\frac{5}{2}}$ orbital the final result appears rather small. (auth)

6551 REDUCTION OF THE GENERALIZED RPA EIGENVALUE PROBLEM. Ullah, Nazakat; Gupta, K. K. (Tata Inst. of Fundamental Research, Bombay). J. Math. Phys. (N. Y.); 13: No. 8, 1163-5(Aug 1972).

The 2n-dimensional eigenvalue problem, which arises when the random phase approximation (RPA) matrix is not real, is reduced to an n-dimensional eigenvalue problem. Some properties of the reduced eigenvalue problem are studied. A numerical example is considered for illustrative purposes. (auth)

6552 PROBABILITIES OF E2-TRANSITIONS AND MEAN VALUE OF QUADRUPOLE MOMENTS OF HIGH SPIN STATES IN ASYMMETRIC TOP MODEL. Gai, E. V.; Rabotnov, N. S. Yadern. Fiz.; 16: No. 2, 284-8(Aug 1972). (In Russian).

Probabilities of E2-transition between states with spins up to J = 16 and mean values of electric quadrupole moments in these states are calculated in the framework of the asymmetric top model with three independent moments of inertia. Theoretical values of ratios $B(E2, J \rightarrow J-2)/B(E2, 2 \rightarrow 0)$ are compared with the experimental data on strongly deformed nuclei. (auth)

6553 INFLUENCE OF SPIN AND QUADRUPOLE INTERACTIONS ON THE PROPERTIES OF THE STATE WITH $K^\pi = 1^+$ IN DEFORMED EVEN-EVEN NUCLEI. Mikhailov, V. M.; Pogosyan, V. V. (Leningrad State Univ.). Yadern. Fiz.; 16: No. 2, 289-300 (Aug 1972). (In Russian).

Energy and reduced probabilities of M1 and E2 excitation of the levels with $K^\pi = 1^+$ are calculated in the random phase approximation. The conditions following from the rotational invariance and from the conservation of orientation the intrinsic axes are taken into account in choosing an effective interaction. It allows one to select quite evidently a virtual state with $K^\pi = 1^+$. The calculations indicate the possibility of existence of electric quadrupole resonances at energy 8 to 10 MeV in deformed even−even nuclei of the rare-earth region. (auth)

6554 CALCULATION OF NUCLEUS DEFORMATION IN THE U(3(A-1)) SCHEME MODEL. Petrauskas, A. K.; Kamuntavichyus, G. P.; Yankauskas, K. I. (Inst. of Physics and Mathematics, Vilnyus, USSR). Yadern. Fiz.; 16: No. 2, 301-9(Aug 1972). (In Russian).

Taking into account the effects of nuclear deformation the possible generalization of the U(3(A − 1)) scheme hamiltonian has been discussed. The relationship between matrix elements in the generalized U(3(A − 1)) scheme and in the nonspherical K-harmonics method basis is found. The method of calculating the density matrix for deformed states with the help of the unitary scheme wave functions is proposed. Examples of determination of the central force matrix are presented. (auth)

6555 OSCILLATIONS OF A FERMI-LIQUID DROP AND GIANT RESONANCE IN MEDIUM AND HEAVY NUCLEI. Akhie-

zer, I. A.; Barts, B. I.; Lazurik-El'tsufin, V. T. (Kharkov State Univ.). Yadern. Fiz.; 15: No. 5, 863-8(May 1972). (In Russian).

Giant resonances in nuclear reactions with medium and heavy nuclei were considered in the Fermi-liquid drop model. Both strong and electric interactions between nucleons were taken into account. Within this model it is possible to describe the experimentally observed position of the giant dipole resonance in photonuclear reactions with large number of nuclei, in particular, to explain slower decrease of the resonance energy with increasing of A than according to the usual liquid model law $A^{-1/3}$. The parameters involved were taken from the analysis of data not related to giant resonance. A number of experimental points don't fall on the curve corresponding to the excitation of dipole oscillations, but fall near the calculated curves which correspond to l = 0 and l = 2. Therefore the experimental determination of corresponding level multipolarity is of large interest. (auth)

6556 INELASTIC HEAVY ION SCATTERING. Rickertsen, Larry Dean. New Haven; Yale Univ. (1972). 123p. University Microfilms Order No. 72-22,519.

Thesis.

The inelastic scattering of heavy-ion projectiles off light nuclei was examined by means of the coupled-channels approach. The macroscopic, one-channel optical potential parametrization of the effective interaction has been examined as a basis for this approach. The effect of ignoring important channels in the reaction as well as the relationship to those approaches which treat the projectile as inert was investigated in detail. The coupling between channels was studied in detail to find those characteristics which will influence elastic and inelastic scattering. The effect of Coulomb excitation was also studied. This approach was applied to the $^{12}C-^{12}C$ reaction and it was found that simultaneous fits to the elastic, singly-excited (2^+), and mutually-excited data are qualitatively as good as those obtained for the elastic scattering in a one-channel approach. The possibility of producing intermediate structure in the excitation functions in this approach was examined and it was concluded that it is unlikely that the structure is produced by couplings to the collective channels. (Diss. Abstr. Int., B)

6557 EFFECT OF THE DEFORMATION-DEPENDENT INERTIAL PARAMETER ON THE PENETRATION OF THE DOUBLE POTENTIAL BARRIER IN FISSIONING NUCLEI. Dudek, J. (Inst. of Nuclear Research, Warsaw). Nucl. Phys.; A194: No. 3, 552-60(1972).

Properties of the double potential barrier transmission coefficient are studied; results of the exact analytic calculations are compared with those obtained in the WKB approximation. The potential is chosen so as to have two rectangular thresholds and a square well in between. The corresponding wave equation is solved, in which the inertial parameter depends freely on deformation, and the resulting analytic expression for the transmission coefficient is used. The approximation of the continuously varying inertial parameter by a step-like function when calculating the fission probability is also examined. (auth)

6558 CALCULATIONS OF THE EXCITATION FUNCTIONS AND ISOMER RATIOS OF THE $^{41}K(\alpha,n)^{44}Sc$ REACTION IN THE EQUILIBRIUM AND PRE-EQUILIBRIUM STATISTICAL MODELS. Oblozinsky, P.; Ribansky, I. (Inst. of Physics, Bratislava). Nucl. Phys.; A195: No. 1, 269-79(1972).

Angular-momentum effects are incorporated in the pre-equilibrium statistical model using Williams' spin-dependent level density as a function of the particle and hole numbers. Excitation functions and isomer ratios for the $^{41}K(\alpha,n)^{44}Sc$ reaction are analyzed both in the equilibrium and pre-equilibrium models in the energy range 8 to 40 MeV. Conventional pairing-energy corrections are introduced and their influence on the pre-equilibrium decay is investigated. The results are compared with published experimental data. The best fit was obtained for almost-pure pre-equilibrium decay with the initial excited-particle-plus-hole number $n_0 = 5$ when pairing corrections were taken into account. No success was achieved in fitting the decrease of the isomer ratios at high energies, which is probably caused by the contribution from direct processes. (auth)

6559 MECHANISM OF $D(\alpha,\alpha p)N$ REACTION. Nakamura, Hiroshi (Aoyama Gakuin Univ., Setagaya-ku, Tokyo). Progr. Theor. Phys. (Kyoto); 48: No. 2, 695-7(Aug 1972).

A theory for the deuteron breakup process induced by α particles, called the "New Impulse Approximation," is improved, and the specific mechanism involved is clarified. (L.T.W.)

6560 UNIFIED DESCRIPTION OF PAIRING CORRELATION IN NUCLEI. Miyanishi, Yoshinao (Nagoya, Univ., Japan). Progr. Theor. Phys. (Kyoto); 48: No. 2, 459-74(Aug 1972).

By the method of linearized equations of motion for the fundamental pair operators, the pairing system in nuclei is treated unifiedly for both the normal and the super region. Any "free" vacuum is not assumed, which enables us the number conserving treatment. With the generalized definition of the gap energy Δ and the chemical potential λ, a new gap equation and the number conserving random phase approximation are derived. The normalization of amplitudes is determined by energy-weighted sum rules. Applications are made to the degenerate case and the two-shell case. The agreement between the theory and the exact solution is good for any interaction strength. An essential point of the theory is that it makes possible a description of the so-called transitional region with slight modifications of the conventional theory. (auth)

6561 DISTRIBUTION OF ENERGY SPECTRA IN A LARGE j SHELL. Nomura, Masao (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 2, 442-58(Aug 1972).

The validity of a gaussian distribution of energy spectra is studied with the help of closed algebraic expressions of the first four moments of energy spectra. A j^n configuration of identical particles, where j is very large, is considered. As a two-body interaction, a quadrupole-quadrupole interaction and several types of random interactions are used. For $j \to \infty$ a simple and general condition is derived for an interaction to produce an energy spectrum which is close to a gaussian distribution, so long as the first four moments are concerned. The interaction which induces a nuclear collective motion yields strong deviation from a gaussian distribution. (auth)

6562 SENSITIVITY OF ELASTIC AND TOTAL CROSS SECTIONS TO THE NUCLEAR SURFACE. Kohmura, Toshitake (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 2, 432-41(Aug 1972).

A new parametrization for the nuclear density distribution is proposed, for which the nuclear scattering amplitude in the Glauber approach can be calculated analytically. The formulation expresses the nuclear density distribution with two parameters, i.e., the nuclear radius and the diffuseness parameter. By using this formulation, it is shown that nuclear scattering at high energies is insensitive to the nuclear diffuseness, especially for scattering at small angles. To obtain information on the nuclear diffuseness from nuclear scattering at small angles, it is required to measure the cross sections with an accuracy of ≈0.1%. (auth)

6563 DERIVATION OF BOHR–MOTTELSON COLLECTIVE MODEL EQUATIONS ON THE BASIS OF MANY BODY PROBLEM HAMILTONIAN. Dzyublik, A. Ya.; Ovcharenko, V. I.; Steshenko, A. I.; Filippov, G. F. (Inst. of Theoretical Physics, Moscow). Yadern. Fiz.; 15: No. 5, 869-79(May 1972). (In Russian).

A possibility to unite the basis of the shell model and collective model for a N particle system is investigated with the use of basis functions of the rotation group representation for a (N – 1)-dimensional space. A simple expression for Hamiltonian may be obtained with an introduction of 3N–9 Euler angles which determine an orientation of three mutually orthogonal vectors in this space, and of six collective variables which characterize a form, dimension and orientation of the system in the usual space. The transformation to the new classic kinetic energy variables is discussed in detail. (auth)

6564 SHORT-RANGE NUCLEON–NUCLEON REPULSION AND LOW-ENERGY THREE-NUCLEON PARAMETERS. Kharchenko, V. F.; Shadchin, S. A.; Storozhenko, S. A. (Inst. of Nuclea. Research, Moscow). Yadern. Fiz.; 15: No. 5, 880-6 (May 1972). (In Russian).

Considering repulsion and attraction potentials of a square well form low-energy three-nucleon parameters (binding energy of triton and nd scattering lengths) are shown to be nonsensitive to the ways of introducing of the short distance internucleon repulsions. (auth)

6565 DEPENDENCE OF POLARIZATION EFFECTS IN DIRECT NUCLEAR REACTIONS ON THE TOTAL ANGULAR MOMENTUM OF AN EXCHANGED PARTICLE. Kolybasov, V. M.; Khangulyan, V. A. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 15: No. 5, 934-8(May 1972). (In Russian).

Polarization effects in direct nuclear reactions A(x,y)B were considered in the pole mechanism approximation taking into account slowly varying terms of the reaction amplitude. The dependence of the total angular momentum of an exchanged particle was investigated for the produced particle polarization as well as for the asymmetry in the products of reactions with polarized initial particles. (auth)

6566 RELATIVISTIC ONE-BOSON-EXCHANGE POTENTIAL AND TWO-NUCLEON DATA. Holinde, K.; Erkelenz, K.; Alzetta, R. (Univ., Bonn). Nucl. Phys.; A194: No. 1, 161-76(1972).

A one-boson-exchange potential (OBEP) represented in momentum space and a helicity state basis is used to calculate the nuclear phase shifts up to 330 MeV from the deuteron and two-nucleon

low-energy data. It satisfies the requirement of minimal relativity and contains off-energy-shell behavior based upon covariant perturbation theory as well as relativistic features like energy dependence. In addition to the scalar $\sigma_0(T = 0)$ and $\delta(T = 1)$ resonances the well-established π-, η-, ρ-, ω- and ϕ-mesons have been exchanged. The good fit to the empirical Livermore data is represented by a least-squares value of 2.6 for 103 pieces of data. The fitted meson coupling constants essentially agree with those known from other sources. The results are compared with those owing to a former OBEP given in the configuration space. (auth)

6567 HYPERFINE INTERACTIONS OF EXCITED NUCLEI IN HIGHLY IONIZED ATOMS. Goldring, G. (Oxford Univ.). J. Phys., A (London): 5: No. 7, 917-28(Jul 1972).

The hyperfine interaction of excited nuclear levels with deeply ionized atoms is discussed. A measurement is reported for $^{18}O[2^+]$ at 1.98 MeV interacting with 7^+ ions in the 1s state. Limits for the g factor of this level are reported as: $0.2 < |g| < 0.36$. The excitation pattern of highly stripped ions is considered, and it is concluded that such ions are formed in two distinct patterns, one characterized by predominant ground state occupation and the other by prolific excitation. The feature which determines the pattern is the degree of isolation of the ground state of the ions. (auth)

6568 PHONON-PARTICLE DOORWAY STATES IN (n,γ) REACTIONS ON NUCLEI WITH N = 28 AND N = 82. Knat'ko, V. A.; Rukak, E. A. (Inst. of Physics, Minsk). Nucl. Phys.; A194: No. 3, 458-62(1972).

The role of phonon-particle doorway states is studied in the de-excitation of the capture state following thermal (n,γ) reactions on ^{50}Ti, ^{52}Cr, ^{54}Fe, ^{138}Ba, ^{140}Ce, and ^{142}Nd. The reduced probabilities of E1 γ-transitions from the capture state to the low-lying p-levels in ^{51}Ti, ^{53}Cr, ^{55}Fe, ^{139}Ba, ^{141}Ce and ^{143}Nd are calculated and compared with the experimental ones. (auth)

6569 RELATION BETWEEN BRUECKNER THEORY AND JASTROW THEORY OF NUCLEAR MATTER. Schaefer, Lothar (Univ., Heidelberg). Nucl. Phys.; A194: No. 3, 497-522(1972).

The two- and three-hole-line contributions to the ground-state energy as calculated from Brueckner theory are derived from a cluster expansion followed by variation of the trial function. The implications of that derivation both for Brueckner theory and for Jastrow theory are worked out in detail. It is argued that the Jastrow theory is able to give simpler methods to calculate the ground state energy which may be of the same accuracy as current Brueckner calculations. It is shown that the single-particle potential of Brueckner theory is intimately related to a subsidiary condition used in the variation of the trial function. The main steps which have to be taken in a derivation of the general hole-line expansion from Jastrow theory are indicated. It is shown that the hole-line expansion is not a cluster expansion in the sense of Jastrow theory, and an interpretation is given of the "self-consistent choice" of the single-particle potential advocated in Brueckner theory. (auth)

6570 STUDY OF CORE EXCITATIONS IN ONE-PARTICLE AND ONE-HOLE NUCLEI BY MEANS OF THE SIX-POINT GREEN FUNCTION. Winter, J. (Univ., Munich). Nucl. Phys.; A194: No. 3, 535-51(1972).

The 2p-1h problem of near-magic nuclei is studied within the framework of the theory of Green functions. The integral equation for the particle-particle-hole (p-p-h) response function given by Ethofer and Schuck is reduced to an eigenvalue problem similar to the known RPA like equations for particle-hole and particle-particle vibrations; it allows one to calculate the doorway part of the mass operator in terms of Migdal's parameters. Besides restriction of the p-p-h irreducible vertex to static effective interactions, a generalization of the quasiparticle approximation plausible for the basic ground states of magic nuclei is used. Factorizations of the six-point function are discussed. A second eigenvalue problem for a direct coupled calculation of the states of 1p and 1h nuclei is derived, yielding energy levels, 1p (1h) and 2p-1h (2h-1p) amplitudes relative to a correlated ground state. (auth)

6571 MULTIPLE ACCELERATION OF NEUTRONS IN AN INVERSELY POPULATED MEDIUM. Petrov, Yu. V. (Inst. of Nuclear Physics, Leningrad). Zh. Eksp. Teor. Fiz.; 63: No. 3, 753-60(Sep 1972). (In Russian).

The interaction between a rarefied neutron gas and an inversely populated medium consisting of nuclei in an excited isomeric state is considered. The neutron spectrum is approximately described by a Gaussian function with a mean energy E_e which considerably exceeds the isomer excitation energy ϵ_m. The conditions of existence and range of applicability of such a distribution are discussed. It is pointed out that the multiplication factor for systems containing nuclei with a fission threshold can be increased by multiple acceleration of the neutrons by the surrounding isomers. (auth)

6572 EXCITATION OF GIANT DIPOLE AND GIANT QUADRUPOLE STATES IN NUCLEI. Satchler, G. R. (Oak Ridge National Lab., Tenn.). Nucl. Phys.; A195: No. 1, 1-25(1972).

Calculations are presented for the excitation by protons of giant dipole (T = 1) and quadrupole (T = 0) states in nuclei. Two simple models are used for the transition densities and potentials in the dipole excitation. The usual deformed optical potential is applied to the quadrupole transitions. The strengths are determined by exhausting the linear energy-weighted sum rules. The relationship to the effective charges needed for transitions between low excited states is discussed. The isovector coupling potential is determined by analysis of (p,n) transitions to analog states. Comparison with data for 61 and 182 MeV protons shows the dipole excitation is too weak, but inclusion of the quadrupole state gives good agreement with the measurements. (auth)

6573 SHELL-MODEL CALCULATION OF THE β^+ STRENGTH FROM ^{115}Xe. Martinsen, P. O.; Randrup, J. (Univ. of Aarhus, Denmark). Nucl. Phys.; A195: No. 1, 26-32(1972).

The spherical shell model with pairing is used to calculate the β^+ strength in the region of light Xe isotopes. The $g_{9/2} \rightarrow g_{7/2}$ core transition is found to dominate the spectrum. A residual force of the GT type is included, and the shell-model prediction of the shape is found persistent. Numerical results are shown for ^{115}Xe. (auth)

6574 SEMICLASSICAL THEORY OF HEAVY ION REACTIONS. Broglia, R. A.; Winther, A. (Univ. of Copenhagen). Phys. Rep.; 4C: No. 4, 153-98(Aug 1972).

The application of the semiclassical theory of direct reactions among heavy ions is discussed. Prescriptions are given to use this picture also for bombarding energies in which the nuclear forces play an important role in defining the trajectory of relative motion of the two colliding ions. The competition between different processes leading to the same final channel and the influence of channels which are strongly coupled to the final channel are discussed in the framework of the semiclassical coupled channel equations of motion. The possibility of including, within the semiclassical scheme, effects of antisymmetrization, recoil and non-orthogonality of the basis vectors is also discussed. (auth)

6575 NUCLEAR MATRIX ELEMENTS ON THE 1.85 MeV BETA TRANSITION IN ^{154}Eu. Subramanian, R. M.; Ganesan, R. (Univ. of Madras). Curr. Sci. (India); 41: No. 18, 685-6(20 Sep 1972).

The Simms formalism was used to reevaluate the matrix elements for the 1.85-MeV first forbidden β transition in ^{154}Eu. The values are in good agreement with those calculated by the Kotani formalism. This indicates that finite nuclear size effects are negligible in this decay. (J.W.R.)

6576 CHARGE FORM FACTORS OF ^6Li, ^9Be, AND ^{12}C NUCLEI IN A THREE-PARTICLE CLUSTER MODEL. Dzhibuti, R. I.; Krupennikova, N. B.; Mamasakhlisov, V. I.; Tomchinskii, V. Yu. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 68: No. 1, 53-6(Oct 1972). (In Russian).

Expressions for the charge form factors of three-particle configurations of ^6Li, ^9Be, and ^{12}C nuclei are obtained by the method of K-harmonics for the cluster model. The form factors are sensitive to the wave functions of the relative motion of clusters in nuclei in the range of low and medium values of the momentum transfer. But in the range of high values of the momentum transfer the α-particle form factor is predominant. (auth)

6577 GENERALIZATION OF THE METHOD OF INTERMEDIATE STRUCTURES IN THE THEORY OF NUCLEAR REACTIONS. Aleshin, V. P.; Tsekhmistrenko, Yu. V.; Chinarov, V. A. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 7, 1090-4(Jul 1972). (In Russian).

The method of intermediate structures is improved and generalized in two directions: 1. The space of L^2 functions which describe the intermediate states is predetermined as a non-orthogonal set; 2. "Resonances of form" (one-particle resonances) are included into a general scheme of intermediate structure resonances by means of constructing some square integrable one-particle function φ_0 which describes the corresponding "intermediate state". The results obtained will be used in the traditional theory of doorway states (e.g., isobaric analog states) and particularly in the description of intermediate structures of cluster type. (auth)

6578 COULOMB WAVE FUNCTIONS IN TERMS OF JACOBI POLYNOMIAL AND GENERALIZED CONFLUENT HYPERGEO-

METRIC FUNCTIONS. Singh, F.; Sharma, L. K. (Government Engineering Coll., Rewa, India). Indian J. Pure Appl. Math.; 3: No. 1, 142-7(Jan 1972).

Analytic expansions of both regular and irregular Coulomb wave functions for all values of angular momentum quantum number L as a product of Jacobi and generalized confluent hypergeometric functions are evaluated. They are deduced with the help of a new expansion formula for Kampé de Fériet function established in this paper and the orthogonal property of Jacobi polynomials. (auth)

6579 STUDY OF NUCLEAR SHELL STRUCTURE AT INELASTIC HIGH-ENERGY ELECTRON SCATTERING. Pasichnyi, A. A. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 7, 1139-47(Jul 1972). (In Russian).

The influence of the light nuclear shell structure on inelastic high-energy electron scattering accompanied by knockout of nucleons is investigated. The role of the nucleon-nucleus interaction in the finite state is shown. The application of the shell model for the description of inelastic electron scattering spectra is studied. (auth)

6580 STUDY OF SPHERICAL EVEN–EVEN AND ODD–PROTONS N 82 NUCLEI WITH A QUASI PARTICLE MODEL. Waroquier, M. E. L. Ghent; Ghent Rijksuniversiteit (1971). 140p. (In Dutch).

Thesis.

The Bogolyubov–Valatin transformation is applied to general shell models; thus the Hamiltonian can be expressed in quasi particle operators. The matrix is diagonalized by the Tamm–Dancoff approximation. Correlations between two or more quasi particle excitations are treated with the random phase approximation and the Barden–Cooper–Schieffer theory is applied to nuclear models. The energy spectra of the even-even ^{136}Xe, ^{138}Ba, ^{140}Ce, ^{142}Nd, and ^{144}Sm nuclei and of the odd-proton ^{137}Cs, ^{139}La, ^{141}Pr, ^{143}Pm, and ^{145}Eu are calculated and compared to experimental values. Formulas for the computation of transition probabilities, magnetic dipole moments and quadrupole moments are presented. (auth)

6581 ROLE OF THE γ-DECAY OF UNBOUND NUCLEAR STATES IN NUCLEON-INDUCED REACTIONS. Decowski, P. (Univ. of Warsaw); Grochulski, W.; Marcinkowski, A. Nucl. Phys.; A194: No. 2, 380-400(1972).

The γ-decay of unbound states was included in statistical calculations of cross sections for nucleon-induced reactions. The results of calculations were compared with the experimental excitation curves for (n,γ), (p,γ), (p,n), (n,n'), (n,2n), and (n,p) reactions. Good agreement between the experimental data and the theoretical calculations was obtained without the use of adjustable parameters. The γ-decay competes successfully with particle emission from high-spin unbound states in the energy region above the thresholds of the (n,2n) and (n,pn) reactions, increasing significantly the cross sections of the (n,n') and (n,p) reactions. (auth)

6582 UNITARY MODEL FOR THREE-BODY COLLISIONS. Cahill, R. T. (Australian National Univ., Canberra). Nucl. Phys.; A194: No. 3, 599-613(1972).

A connected 3 → 3 formalism for three-body collision processes is reduced to a hierarchy of three on-energy-shell integral equations and one off-energy-shell integral equation. Only the on-energy-shell equations, which involve only on-energy-shell three-body and two-body amplitudes, need be solved exactly in order to obtain elastic and break-up amplitudes satisfying the unitarity constraints exactly. Applied to n-d break-up, the on-energy-shell equations ensure that the n-d initial-state interaction, the nucleon-nucleon final-state interactions, and more complicated 3 → 3 processes are correctly described. After angular momentum analysis the on-energy-shell equations are one-dimensional integral equations, even in the case of local two-body potentials. This unitary model provides a practical scheme for calculating approximate three-body elastic and break-up amplitudes when two-body local potentials are used to describe the two-body subsystems. (auth)

6583 GENERATOR-COORDINATE METHOD FOR THE SCATTERING OF IDENTICAL HEAVY IONS. Fliessbach, Torsten (Technische Univ., Munich). Nucl. Phys.; A194: No. 3, 625-41(1972).

The possibilities of using the resonating-group method or the generator-coordinate method for heavy ions above the Coulomb barrier are critically investigated. Special attention is paid to the problem of redundant solutions. It is shown that both methods in the present form are impracticable due to the difficulties of the antisymmetrization. A modified generator-coordinate ansatz is given which is numerically treatable. We find a qualitative solution for the corresponding integral equation. In connection with the wave function of relative motion, the question of a reasonable definition for the optical potential is discussed. The real part of an optical potential for ^{16}O–^{16}O and its energy dependence are calculated. (auth)

6584 MATRIX ELEMENTS IN THE ORTHOGONAL SCHEME. Yankauskas, K. I.; Petrauskas, A. K. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 11: No. 6, 997-1006(1971). (In Russian).

General properties of the matrix elements of translational invariant one- and two-particle operators in the orthogonal scheme are discussed. By using the relation between matrix elements in the orthogonal scheme and in the K-harmonics basic the recurrence formula for calculation of the matrix element is obtained. The calculation technique of central internuclear interacting matrix elements is discussed in detail. (auth)

6585 STRIPPING CALCULATIONS FOR UNBOUND STATES. Schlessinger, L.; Payne, G. L. (Univ. of Iowa, Iowa City). Phys. Rev., C; 6: No. 6, 2047-57(Dec 1972).

A procedure is presented which leads to a well-defined, convergent method for extending ordinary distorted-wave Born-approximation (DWBA) analysis to the calculation of scattering to long-lived resonant states. This method is based upon the use of a normalized wave function for the resonant state. The cross section calculated with this wave function is correct to terms of the order of Γ/E_0, the ratio of the resonance width to its energy. To illustrate this technique the cross section for the ^{16}O(d,p)^{17}O transfer reaction to the resonant 5.08-MeV state of ^{17}O is calculated. The results are compared to those obtained by other methods and are found to agree to order Γ/E_0. (auth)

6586 THREE-BODY CORRELATIONS IN NUCLEAR MATTER. Day, B. D. (Argonne National Lab., IL); Coester, F.; Goodman, A. Phys. Rev., C; 6: No. 6, 1992-2010(Dec 1972).

The possibility of computing the three-body correlation energy in nuclear matter by direct solution of integral equations in momentum space is studied. An important feature of the procedure is that the off-energy-shell reaction matrix, which comes from an arbitrary two-body potential, is approximated by a sum of separable terms. Detailed numerical calculations are made for an S-wave force consisting of the Reid $^1S_0$ potential acting in both singlet and triplet states. The main results are as follows: The Reid $^1S_0$ reaction matrix can be accurately represented by two or three separable terms for all relative momenta, k, in the region $0 < k < 8$ fm^{-1}; this is the relevant region for the calculations. Integrals over momenta can be adequately approximated by finite sums over only 6 or 8 Gauss points. Many three-body states can be adequately treated in lowest order and, therefore, do not appear in the integral equations. On the basis of these results, it is estimated that a calculation using the full nuclear force would require the solution of systems of 100 to 200 linear equations. Solving such systems is perfectly feasible with present-day computers. The three-body correlation energy was calculated at three different densities for the assumed two-body force. (auth)

6587 EFFECTS OF THE ADDITION OF A NEUTRON ON NUCLEAR PROPERTIES OF p–f SHELL NUCLEI. Parikh, J. K. (Bhabha Atomic Research Centre, Bombay). Phys. Rev., C; 6: No. 6, 2177-88(Dec 1972).

In order to study the effects of the addition of neutrons, one has to study the even as well as odd isotopes of a given nucleus. For this reason, the Hartree–Fock–Bogolyubov formalism, which is available for even–even nuclei, is extended to the even–odd nuclei. The blocking effect introduced by the odd nucleon is taken into account in the formalism. Numerical calculations are carried out for 22 nuclei of the p–f shell (the isotopes of Ti, Cr, Fe, and Zn) with ^{40}Ca considered as a doubly closed core. By comparing the results for the odd nuclei with the results for the even–even nuclei, the spectra of which were obtained in earlier work, one understands the effects of the addition of neutrons on the nuclear properties such as the deformation, Fermi surface, saturation properties of the nuclear force, single-particle levels, and the pickup strengths. The calculated binding energies, separation energies, pair separation energies, B(E2) values, quadrupole moments, and the neutron and proton pickup strengths compare very well with the experimental values. The possibility of obtaining the "equivalent deformation" for which the Nilsson levels correspond to the calculated single-particle levels is discussed. (auth)

6588 REGGE DESCRIPTION OF OPTICAL-MODEL SCATTERING. Tamura, T.; Wolter, H. H. (Univ. of Texas, Austin). Phys. Rev., C; 6: No. 6, 1976-91(Dec 1972).

The analytic continuation of the S matrix into the complex angular momentum plane is performed exactly for the Woods–

Saxon-type optical potentials, thereby describing the elastic scattering of spinless but charged particles. The properties of this S matrix, such as the nature of the pole trajectories and the behavior of the background integral, are investigated for several specific cases. With reference to these exact calculations, the validity of various approximations made in the Regge theory is assessed. It is found that approximations which retain only the pole terms are generally poor, being quite sensitive to the number and the positions of the poles and converging very slowly with an increasing number of poles; on the other hand, models using a simple analytic background term, in addition to one pole term, are found to reproduce the exact Regge amplitude quite accurately under favorable conditions. Suggestions are made for the possibility of extending this idea into a background-plus-several-pole model, when the background–one-pole model fails. (auth)

6589 EQUATIONS FOR FOUR-PARTICLE SCATTERING. Sloan, I. H. (Univ. of Maryland, College Park). Phys. Rev., C; 6: No. 6, 1945-55(Dec 1972).

Four-particle scattering equations are obtained that are analogous to the Lovelace or Alt–Grassberger–Sandhas equations in the three-particle case: They are equations whose kernel is connected after one iteration, in which the unknown quantities are the transition operators for the various elastic, inelastic, and rearrangement processes. The equations couple together only the transitions to the two-body channels, exactly as in the three-particle analogs, so that there are seven coupled integral equations, corresponding to the seven two-body channels (four of nucleon + triton type, and three of deuteron + deuteron type). Transition operators to the three- and four-body channels appear as integrals over the transition operators to the two-body channels. (auth)

6590 MULTIPOLE THEORY OF NEUTRINO–NUCLEAR REACTIONS: APPLICATION TO ^{12}C. Ueberall, H. (Catholic Univ. of America, Washington, DC); Lamers, B. A.; Langworthy, J. B.; Kelly, F. J. Phys. Rev., C; 6: No. 6, 1911-24(Dec 1972).

The cross section for neutrino-induced nuclear reactions is presented in the form of a multipole expansion, appropriate for the excitation of nuclear levels of a definite spin and parity. The theory is then applied to the T = 1 levels of ^{12}C, knowledge of their excitation cross sections being required for both low-energy ($E_\nu \leq 53$ MeV, with neutrinos from stopped muons) and high-energy ($E_\nu \sim$ GeV) neutrino experiments that use counters containing carbon. A phenomenological approach is taken, the needed transition densities being determined from fits to the measured form factors of these levels for the closely related electroexcitation process. While the low-energy cross section is dominated by the excitation of the 1^+ ground state of ^{12}N, the high-energy cross sections receive their largest contributions from both positive-parity spin-flip states and especially from the 1^- giant-resonance levels, with additional strength from 3^+ and 2^- 4^- levels. (auth)

6591 COMPARISON OF IMPULSE-APPROXIMATION AND ELEMENTARY-PARTICLE TREATMENTS IN NUCLEAR β DECAY. Armstrong, Lloyd Jr.; Kim, C. W. (Johns Hopkins Univ., Baltimore). Phys. Rev., C; 6: No. 6, 1924-34(Dec 1972).

The usual impulse-approximation and the elementary-particle treatments of nuclear processes are compared by using nuclear β decays as examples. Both treatments are shown to lead to essentially equivalent results for allowed transitions and for natural-parity-forbidden transition of the types $\Delta J^{P_i P_f} = 1^-$ and possibly 2^+, 3^-, ... There exist, however, some differences in detailed structures in small correction terms. In the case of unnatural-parity-forbidden transitions, in particular, $J_i^{P_i}(0^-) \rightarrow J_f^{P_f}(0^+) + e^- + \bar{\nu}_e$, there exist some discrepancies between the two approaches, these discrepancies suggesting an important role of meson-exchange corrections in the impulse approximation. (auth)

6592 TRINUCLEON CALCULATION WITH REALISTIC INTERACTIONS. Benayoun, J. J.; Gignoux, C. (Institut des Sciences Nucleaires, Grenoble, France). Lett. Nuovo Cim.; 5: No. 4, 313-14(23 Sep 1972).

Nuclear ground-state properties of the triton were calculated using the Faddeev equations and three different realistic interactions. The interactions used were the Reid soft-core potential, the Bressel–Kerman–Rouben potential and the Cogny–Pires–De Toureil potential. The results are compared with those obtained by basically different solutions of the Faddeev equations. (J.W.R.)

6593 TRINUCLEON WITH RANK-TWO SEPARABLE POTENTIALS. Pace, E. (Univ., Rome); Nunberg, P.; Prosperi, D. Lett. Nuovo Cim.; 5: No. 4, 327-32(23 Sep 1972).

A preliminary investigation of the possibility of fitting two- and three-body properties with rank-two separable potentials was made. Charge radii of the triton and ^3He and the triton binding energy were calculated. The results are discussed in terms of the D-state percentage of the deuteron. (J.W.R.)

6594 EVIDENCE FOR CORE POLARIZATION EXCHANGE CONTRIBUTION IN INELASTIC SCATTERING. Geramb, H. V.; Strobel, G. L.; Sprickmann, R. (Kernforschungsanlage, Juelich, Ger.). Lett. Nuovo Cim.; 5: No. 4, 333-7(23 Sep 1972).

A microscopic antisymmetrized distorted-wave approximation including a two-step polarization reaction mechanism was used to study the proton inelastic scattering from the ^{16}O 2^- state. The $O^+ \rightarrow 2^-$ transition was considered to proceed only by spin-flip mechanisms. The results indicate that this transition can be explained by a coherent sum of the one-step valence mechanism and the core polarization exchange mechanism. (J.W.R.)

6595 PAIR DISTRIBUTION FUNCTION AND THE CONDITIONS IMPOSED IN JASTROW METHOD FOR NUCLEAR MATTER. Grypeos, M. E. (Univ. of Thessaloniki, Greece); Mavrommatis, E. Lett. Nuovo Cim.; 5: No. 4, 369-72(23 Sep 1972).

A restriction on the nucleon-nucleon correlation function of the Jastrow method is discussed. The energy per nucleon in nuclear matter is calculated using the condition and compared with Jastrow calculations with other restrictions on the correlation function. A definite improvement was found. (J.W.R.)

6596 GREEN FUNCTION INTERPRETATION OF BRUECKNER THEORY. Tolmachev, V. V. (Moscow State Univ.); de Llano, M. Rev. Mex. Fis.; 21: No. 1, 61-84(1972).

The basic features of Hartree–Fock theory are the presence of a single-particle hermitean common potential well operator and the associated spectrum of (real) energies and orbitals. The need for a renormalized Hartree–Fock approach to the perturbation-theoretic study of many-fermion systems arises from the possible singular nature of the two-body force as appears, e.g., in ^3He atoms and nucleons. The Brueckner–Hartree–Fock and the Bethe–Brandow–Petschek theories (both of which retain the idea of real single-particle energies, orbital eigenfunctions and a hermitean common potential) are deduced from the diagrammatic Dyson equation for the exact one-particle Green function. Consequently, the set of assumptions that must go into this equation in order to obtain the different variants of Brueckner theory are rendered transparent and compact. (auth)

6597 DEGREES OF NUCLEAR ORIENTATION. Dzhrbashyan, V. A. (Erevan Physics Inst.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 6, 433-8(1971). (In Russian).

The degree of orientation of an arbitrary order for the statistical ensembles is considered in connection with the discovery of high spin nuclear levels. The theorem pointing out the simple view of $f_k(I)$ in the first nonvanishing approximation is proved. (auth)

6598 GAMMA ANISOTROPY IN THE CASE OF POLARIZATION OF NUCLEI BY GORTER–ROSE METHOD. Dzhrbashyan, V. A. (Erevan Physics Inst.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 6, 439-48(1971). (In Russian).

The most general formulas of existing ones are obtained for the degrees of orientation by which the gamma-anisotropy is expressed. The physical reason of the dependence on the external field H of the order of some hundred oersteds, for T ~ 0.01°K, turns to be the counteraction of nucleus. In the case of ^{60}Co the theory agrees with the experiment in the temperature interval of 0.0056°K < T < 0.01°K. (auth)

6599 MICROSCOPIC THEORY OF COMPLEX COLLISIONS. Yukawa, T. New Brunswick, N. J.; Rutgers–The State Univ. (1972). 128p. University Microfilms Order No. 72-27,617. Thesis.

A theory of complex collisions, which is appropriate for a microscopic description of heavy ion reaction mechanisms, is proposed. The theory is based on the completeness assumption of a set of antisymmetrized products of the shell-model wave functions; by this we mean that any state Ψ of a many-nucleus system can be constructed by a linear superposition of the set of basis functions Φ: where the basis function is specified by a set of internal state quantum numbers $\{a_1 .. a_N\}$ and a set of parameters $\{\vec{R}_1 .. \vec{R}_N\}$ which represents the location of the centers of the shell-model well for each nucleus of the system. The many body Schrödinger equation and the equations given by the scattering theory of Eckstein are represented by the basis set, the Pauli principle is fully taken into account. Two sets of coupled integral equations, which resemble that of the generator coordinate method, are obtained and reduced to sets of coupled integro-differential equations which are able to provide a simple physical

picture for the scattering process of complex particles. The interactions between composite particles, which have a direct relation to the T-matrices for elastic, inelastic and rearrangement collisions, are expressed in terms of the shell-model wave functions of nuclei of the system and the nucleon-nucleon interaction. For practical calculations, an approximate method of obtaining the interaction kernels is proposed and applied to the ^{16}O-^{16}O system within a single-channel approximation. Finally, the relationships to the static potential model and the resonating group method are discussed. (Diss. Abstr. Int., B)

6600 α-PARTICLE MODEL OF LIGHT NUCLEI. Coelho, H. T. Philadelphia; Univ. of Pennsylvania (1972). 121p. University Microfilms Order No. 72-25,552.

Thesis.

In elastic scattering experiment of α-particles from light N = Z = even nuclei one observes striking forward and backward peaks. A solution of this problem, within the framework of the α-cluster model, requires the knowledge of the interactions between α-particles and between an incident α and a nucleus. Three phenomenological $\alpha-\alpha$ potentials were "constructed" from a least square fit of the experimental $\alpha-\alpha$ cross-section. By direct calculation, it is shown that the heavy particle transfer and the lowest order triangle diagrams embody a model which was capable of explaining the backward and forward elastic angular distribution of the cross section in $^{16}O(\alpha,\alpha)^{16}O$. The α-nucleus interaction is part of the model. The comprehension of the model also requires the study of α-cluster wavefunctions for the virtual decays: $^{16}O \rightarrow \alpha + {}^{12}C$ and $^{12}C \rightarrow \alpha + {}^{8}Be$. Ground state wavefunctions (gsw) for ^{16}O and ^{12}C were constructed. The gsw of ^{16}O was expanded in a product basis of ^{12}C states and relative motion of the fourth α-particle with respect to ^{12}C. A corresponding expansion is used for the ^{12}C ground state. From these expansions, the probability amplitudes for transfer of ^{12}C and ^{8}Be as intermediate states were obtained. Best choices of coordinate systems for the description of the virtual breakup reactions were discussed using the concept of "democracy." The techniques developed and used in this work can be applied to the other 4n nuclei to answer similar types of questions. (Diss. Abstr. Int., B)

6601 INTERNAL CONVERSION COEFFICIENTS FOR HIGH-ENERGY TRANSITIONS. **Trusov, V. F. (Latvian State Univ., Riga). Nucl. Data, Sect. A; 10: No. 6, 477-510(1972).**

The K- and L-shell internal conversion coefficients for transition energies above 1 MeV are presented. The coefficients are given for the two lowest electric and magnetic multipoles in the region $16 \leq Z \leq 99$ for K-shell and for the four lowest multipoles in the region $50 \leq Z \leq 100$ for L-shell. (auth)

6602 REDUCED ROTATION MATRIX: PLOTS AND ZEROS. **Cramer, J. G. (Univ. of Washington, Seattle); Braithwaite, W. J. Nucl. Data, Sect. A; 10: No. 6, 469-76(1972).**

The reduced matrix elements of finite rotations in the angular momentum representation $\{d^{j}_{m'm}(\beta)\}$ are presented in polar plots and root tables for several low spins having both integral and half-integral values. The plots present, for $j \leq 5/2$, the magnitude of the matrix element as the length of the radius vector at the polar angle which corresponds to the Euler angle of rotation. The tables present those values of β, in the region $0 \leq j \leq 8$, which satisfy the condition $d^{j}_{m'm}(\beta) = 0$. (auth)

6603 COLLECTIVE PROBLEM IN THE 2s–1d SHELL. **Harvey, M. (Chalk River Nuclear Labs., Ont.). pp 1-25 of Fourth Symposium on the Structure of Low-Medium Mass Nuclei. /Davidson, J. P. (ed.). Lawrence, Kan.; University Press of Kansas (1972).**

From fourth symposium on the structure of low-medium mass nuclei; Lawrence, KS. (12 Oct 1970). See CONF-701073.

Studies involved in recognizing low-energy collective phenomena in the 2s–1d shell using qualitative macroscopic models and trying to understand how these collective features arise in the models are discussed. The philosophy is to examine data from complex nuclei and ask what it tells about the general structure of the nucleus and the form of the effective interaction. It is concluded that rotational features at the beginning of the 2s–1d shell are in the spirit of the SU_3 shell model, i.e., band cutoffs should be expected; vibrational spectra do exist at the end of the shell but it is not obvious that the shell model is capable of reproducing them; the two-body vector and tensor forces do not contribute much to the average Hartree–Fock field, and what they do contribute can be simulated by an additional single-particle spin–orbit force; the single-particle spin–orbit force describes the main differences between the SU_3 model and the Hartree–Fock model; and the spin–orbit force tends to soften the nucleus although, in the harmonic approximation, this appears to be no greater for nuclei at the end of the shell than at the beginning. (11 figures, 5 tables) (R.W.R.)

6604 REACTION MATRIX THEORY FOR NUCLEAR STRUCTURE. **Kuo, T. T. S. (State Univ. of New York, Stony Brook). Contract AT(20-1)-4032. pp 75-111 of Fourth Symposium on the Structure of Low-Medium Mass Nuclei. /Davidson, J. P. (ed.). Lawrence, Kan.; University Press of Kansas (1972).**

From fourth symposium on the structure of low-medium mass nuclei; Lawrence, KS. (12 Oct 1970). See CONF-701073.

The method for doing nuclear structure calculations by using a realistic nucleon–nucleon interaction in the framework of the Green's function method is treated. The Green's function formalism is first outlined. The method for summing all the two-body correlations to obtain the reaction matrix is then discussed. This step is necessitated by the presence of the strong short-range repulsions in nucleon–nucleon potentials. Since the effective nucleon–nucleon interactions in nuclei are energy dependent in this formalism, the nuclear energy spectrum must be calculated in a self-consistent way. Preliminary results of a self-consistent calculation of the energy spectra of ^{18}F and ^{18}O are presented. (15 figures, 4 tables) (R.W.R.)

6605 ANATOMY OF THE HARTREE–FOCK PROCEDURE IN A SIMPLE MODEL. **Harvey, M. (Chalk River Nuclear Labs., Ont.). pp 166-72 of Fourth Symposium on the Structure of Low-Medium Mass Nuclei. /Davidson, J. P. (ed.). Lawrence, Kan.; University Press of Kansas (1972).**

From fourth symposium on the structure of low-medium mass nuclei; Lawrence, KS. (12 Oct 1970). See CONF-701073.

An analysis of a simple problem that sheds light on the peculiarities which sometimes occur in seeking Hartree–Fock solutions is discussed. With such a problem one can see under what conditions the Hartree–Fock solution is a good approximation to the lowest eigensolution to the Hamiltonian, and whether all the Hartree–Fock solutions have any physical meaning. The Hartree–Fock iterative procedure is also studied. Finally, the representation of energy surfaces is considered; strange-looking results can be obtained if such surfaces are not plotted against the appropriate variable. (4 figures) (R.W.R.)

6606 INFLUENCE OF A QUASIPARTICLE SPIN–ORBIT INTERACTION ON MAGNETIC MOMENTS OF LIGHT NUCLEI. **Glas, Dieter (Justus Liebig Univ., Giessen, Ger.). Z. Phys.: 255: No. 2, 175-86(1972). (In German).**

Using Migdal's theory of interacting quasiparticles, the influence of a two-body spin-orbit interaction in addition to the spin-spin interaction on magnetic moments of nuclei was investigated in the mass region A = 11 to A = 65. The coupling constants of the spin-orbit interaction were determined from spin-orbit splittings of single particle energies, and those of the spin-spin interaction were adjusted by fitting magnetic moments. The constants of the spin-spin interaction were found to be dependent on the mass value. The inclusion of the spin-orbit interaction led to a better agreement of theoretical and experimental magnetic moments of light nuclei. The spin-orbit contribution was averaged 7% over all nuclei, but reached 20–30% for some of them. (auth)

6607 OFF-SHELL EFFECTS IN ^{16}O. **Haftel, M. I. (Naval Research Lab., Washington, D. C.); Lambert, E.; Sauer, P. U. Nucl. Phys., A192: No. 2, 225-45(1972).**

The binding energy of ^{16}O was calculated for a set of phase-shift-equivalent potentials previously studied in nuclear matter. Off-shell variations of up to 2.8 MeV per particle occur compared with about a 10 MeV per particle variation in nuclear matter. As in nuclear matter calculations a nearly linear relation exists between the variations in the binding-energy results and the wound integral κ. The ^{16}O results were compared with a nuclear matter calculation at the "equivalent" nuclear matter density of $\kappa_F = 1.13\ fm^{-1}$. This "equivalent" density reflects the fact that ^{16}O has a surface and hence a lower average than nuclear matter. The ^{16}O and nuclear matter off-shell variations are comparable once one takes into account the lower average density of ^{16}O and the suppression of the relative D-wave interaction–also a surface effect. A method of computing the correlated wave functions of finite nuclear systems is presented. The correlated wave functions of ^{16}O and of nuclear matter are strikingly similar for all of the potentials studied. (auth)

6608 DESCRIPTION OF NUCLEAR COLLECTIVE MOTIONS IN TERMS OF THE BOSON EXPANSION TECHNIQUE. I. FORMULATION. **Kishimoto, T.; Tamura, T. (Univ. of Texas, Austin). Nucl. Phys., A192: No. 2, 246-78(1972).**

The boson expansion technique for the description of nuclear

collective motion, previously worked out by Sørensen to fourth order, is first refined and then extended to sixth order. The equations for the coefficients in the expansion of the fermion-pair operators in terms of boson operators are solved exactly to sixth order. The collective Hamiltonian is then given also to sixth order, and rewritten in a form for which the evaluation of its matrix elements in the multiboson space can be carried out extremely easily. The scope of numerical calculations to be performed based on the results of the present article is also discussed. (auth)

6609 PROBABILITY OF INTERNAL IONIZATION IN β-DECAY. Mord, A. J. (Univ. of Oregon, Eugene). Nucl. Phys., A192: No. 2, 305-11(1972).

The probability P_K of K-shell internal ionization during β-decay has been calculated for 14 isotopes according to the theory of Stephas and Crasemann. The relativistic hydrogenic atomic matrix element has been re-evaluated exactly, eliminating a divergence at low electron momenta that occurred in the approximate form of the matrix element. The results are presented for three distinct definitions of P_K in current use. Calculated values of P_K are substantially smaller than measured probabilities. Possible sources of the discrepancy are indicated. (auth)

6610 QUASIPARTICLE CALCULATIONS WITH LOCAL POTENTIALS ABOVE THE THREE-PARTICLE BREAK-UP THRESHOLD. Ziegelmann, H. (Univ., Tuebingen, Ger.). Nucl. Phys., A192: No. 2, 426-32(1972).

The Alt-Grassberger-Sandhas equations are solved above the three-particle break-up threshold in the case of three identical spinless particles interacting via Yukawa potentials in the zeroth- and first-order quasi-Born approximation. The differences in the calculated phase shifts and total break-up cross sections between the two approximations indicate the importance of the non-separable part of the local potential, which is taken into account by the first-order approximation. (auth)

6611 POLARIZATION OF α-CLUSTERS IN LIGHT NUCLEI. Gruemmer, F.; Faessler, Amand (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 255: No. 2, 112-18(1972).

The α-particle model of Brink is extended to allow for non-spherical clusters. This is done by admixing p-functions to the s-single particle states which represent, in the usual version of the model, the nucleons in a cluster. The results in the nuclei ^{8}Be, ^{12}C, ^{16}O, and ^{20}Ne indicate that the spherical clusters represent the stable configurations. (auth)

6612 COMPILATION OF PHENOMENOLOGICAL OPTICAL-MODEL PARAMETERS, 1969–1970. Perey, C. M.; Perey, F. G. (Oak Ridge National Lab., Tenn.). Nucl. Data, Sect. A; 10: No. 6, 539-66(1972).

A pilot compilation, with bibliography, of optical-model parameters determined by fitting elastic-scattering angular distributions for various incident particles including heavy ions was made. (auth)

6613 QUASI-GROUND, QUASI-BETA, AND QUASI-GAMMA BANDS: 1972. Sakai, M. (Tokyo Univ.). Nucl. Data, Sect. A; 10: No. 6, 511-38(1972).

For even-even nuclei a list is presented of the probable members of quasi-ground, quasi-beta, and quasi-gamma bands of the spherical regions and the corresponding ground, beta, and gamma bands of the deformed regions. For simplicity the term "quasi" is used for both regions. References are given to the experimental data basic to the level assignments. The literature has been covered through March 1972. (auth)

6614 POSITRON- AND ELECTRON-INDUCED FISSION (DISINTEGRATION) CROSS-SECTIONS IN THE FIRST BORN MODIFIED APPROXIMATION. Sinha, B. B. P.; Goldemberg, J. (Univ. of Toronto). Lett. Nuovo Cim.; 5: No. 1, 37-40 (2 Sep 1972).

The first Born approach for positron- and electron-induced fission and disintegration reactions is modified to include acceleration and distortion effects due to the nuclear Coulomb field. Calculations are performed for several nuclei and compared with experimental data. (J.W.R.)

6615 MULTIPOLE DEFORMATIONS, STATIC QUADRUPOLE MOMENTS AND ELECTROMAGNETIC TRANSITIONS IN LIGHT NUCLEI. Abgrall, Y. (Univ., Bordeaux); Morand, B.; Caurier, E. Nucl. Phys., A192: No. 2, 372-90(1972).

Hartree-Fock calculations have been performed in light 4n nuclei from ^{8}Be to ^{28}Si using central interactions. The rms radii, static quadrupole moments and electromagnetic transition rates have been deduced exactly from the angular momentum projected wave functions obtained in a projection before variation (PBV) procedure. The quadrupole and hexadecapole deformations of the intrinsic states are compared with the experimental results deduced recently from the analysis of electron, proton and α-particle inelastic scattering data. The whole system of A nucleons is treated and consequently no additional effective charge is introduced. A detailed comparison with experiment is made and good agreement is obtained, with some exceptions in ^{12}C and ^{28}Si. The projected HF description is compared with other microscopic investigations of light nuclei and with the phenomenological rotational-model predictions. The importance of the PBV procedure is displayed and remarks are also made concerning the usual approximations used to deduce the nuclear properties from the HF wave functions. (auth)

6616 DISPLACEMENT CROSS SECTIONS FOR (n,2n) REACTIONS. Odette, G. R. (Univ. of California, Santa Barbara). Trans. Amer. Nucl. Soc.; 15: No. 2, 632-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6617 APPLICATION OF BINOMIAL STATISTICS TO NUCLEAR PROCESSES. Sandquist, G. M. (Univ. of Utah, Salt Lake City); Rogers, V. C. Trans. Amer. Nucl. Soc.; 15: No. 2, 709-10(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6618 METHODS OF ATOM DENSITY INTERPOLATION USED WITH ABBN CROSS SECTIONS. Fussell, J. B.; Blink, J. A. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 15: No. 2, 909(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6619 CALCULATION OF HEAVY-ION INTERACTIONS. Bertini, H. W.; Gabriel, T. A.; Santoro, R. T.; Hunt, J. D. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 968(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

PHYSICS (PLASMA AND THERMONUCLEAR)

6620 PLASMA PHYSICS INDEX. VOLUME 7, No. 9, 1972. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.: Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 194p.

This listing contains 525 references on various aspects of the subject. (M.O.W.)

Confinement and Heating

Refer also to abstracts 6702 and 6766.

6621 (AD-743286) PLASMA HEATING NEAR THE ION CYCLOTRON FREQUENCY AND ITS HARMONICS. Clark, R. W.; Swanson, D. G. (Texas Univ., Austin. Electronics Research Center). 1 Dec 1971. Contract F44620-71-C-0091. 134p. (AFOSR-TR-72-407). NTIS.

Additions were made to the theory of the quasi-ion Bernstein modes that propagate for wave frequencies near the harmonics of the ion cyclotron frequency and experience ion cyclotron damping as the harmonic resonances are approached. The effects of collisions and electron Landau damping were included, and group velocity calculations were performed. When the effects of collisions are included, the theory predicts strong collisional damping in high-density, low-temperature, collision-dominated plasmas, whereas the original theory predicted wave propagation in the absence of collisions. (auth) (GRA)

6622 (AEC-tr-7360) MICROWAVE PLASMA HEATING EXPERIMENTS IN TUMAN-2 DEVICE. Golant, V. E.; Kaganskii, M. G.; Pakhomov, L. P.; Podushnikova, K. A.; Shakhovets, K. G. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Inst.). Translated from report NP-19160. 16p. Dep. NTIS.

The experiments on shf plasma heating in a toroidal magnetic trap were carried out at frequencies corresponding to the upper hybrid frequency range. In the area of plasma concentration of (1 to 3) $\times 10^{12}$ cm^{-3} at frequency f = 9 Gc and power P = 80 kW, the efficiency of shf energy input, which was determined by the changes of the plasma parameters, reached several tens of percent. At concentrations of (1 to 2) $\times 10^{13}$ cm^{-3} and shf source frequency f = 34 Gc, the energy input efficiency was 5 to 10%. The efficiency difference at various frequencies may be connected with the effect of the evanescence region since the wavelengths were substantially smaller than the chamber dimensions. (auth)

6623 PLASMA AND LARGE CURRENTS IN NUCLEAR FUSION. Cihelka, J.; Husa, V.; Ladnar, J. (Research Inst. of Electrical Engineering, Bechovice, Czech.). Elektrotech. Obz.; 60: No. 6, 301-7(Jun 1971). (In Czech).

An outline is given of problems relating to nuclear fusion. Basic ideas on the possibility of fusion, the conditions of its materialization, and different possible ways of the insulation of plasma are explained. Certain systems of a magnetic insulation of plasma and the stabilization of the magnetic field and certain typical experimental fusion equipment are described. The problems of large currents are indicated and specific problems of the switching and control technique are presented. (NSA of Czech.)

6624 PLASMA CONFINEMENT IN A RACETRACK MAGNETIC FIELD WITH A DIVERTER. Zykov, V. G.; Karpukhin, V. I.; Lonin, Yu. F.; Rudnev, N. I.; Tolok, V. T. (Physical-Technical Inst., Kharkov). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 744-9(Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 939-45(May 1972).

Confinement of a plasma injected into a racetrack magnetic field with a diverter is studied. It is shown that an equilibrium plasma can be produced without a rotational transform because of the diverter field. The plasma-density decay time exceeds the Bohm time $\tau_B = \pi a^4 eH/ckT$ by roughly an order of magnitude; the particle lifetime is not a linear function of the confining field, but is described by $\tau \sim H^\alpha$, where $1 < \alpha < 2$. (auth)

6625 ANOMALOUSLY RAPID CURRENT PENETRATION IN A TOROIDAL TURBULENT HEATING EXPERIMENT. Hirose, A.; Kawabe, T.; Skarsgard, H. M. (Univ. of Saskatchewan, Saskatoon). Phys. Rev. Lett.; 29: No. 21, 1432-4(20 Nov 1972).

The behavior of the plasma-current penetration in a toroidal device was investigated for a wide range of plasma density ($10^{11} \lesssim n \lesssim 10^{13}$ cm^{-3}). The observed rapid penetration cannot be attributed to the enhancement of plasma resistivity. A possible explanation is proposed in terms of electrostatic instabilities driven by electron velocity gradients. (auth)

6626 EXPERIMENTAL EVIDENCE OF MULTIPLE-MIRROR PLASMA CONFINEMENT. Logan, B. G.; Brown, I. G.; Lieberman, M. A.; Lichtenberg, A. J. (Univ. of California, Berkeley). Phys. Rev. Lett.; 29: No. 21, 1435-8(20 Nov 1972).

Enhanced confinement of thermally ionized potassium plasma with increasing number of magnetic mirrors was observed in a steady-state single-ended Q machine. The improved confinement occurs in an intermediate mean-free-path regime, and is in good agreement with theory. (auth)

6627 PLASMA CONFINEMENT IN TOROIDAL RINGLESS QUADRUPOLE. Azumi, M.; Mohri, A. (Nagoya Univ., Japan). Phys. Lett.; 42A: No. 1, 81-2(6 Nov 1972).

It is experimentally shown that plasma trapped in a toroidal helical winding system, including a large separatrix, becomes asymmetric in its structure against the meridian plane of the torus. (auth)

6628 ANOMALOUS HEATING OF A PLASMA BY A LASER. Yamanaka, C. (Osaka Univ.); Yamanaka, T.; Sasaki, T.; (and others). Phys. Rev., A.; 6: No. 6, 2335-42(Dec 1972).

As lasers have an ability to deliver a large amount of energy very rapidly to matter, one can produce a plasma of thermonuclear temperature by laser bombardment of matter. The neutron yield was observed from a solid deuterium target irradiated by the beam of a glass laser, which had a power of 20 GW for 2 nsec. The theoretically estimated threshold laser power for anomalous heating owing to the parametric instability was in agreement with the experimental result. Above this threshold, an increase in the electron temperature, the appearance of a fast-ion group, and an anomaly in the reflection of light from the plasma were observed. These phenomena were closely correlated with the neutron yield. At the high-temperature region above a few hundred electron volts, the anomalous heating plays an essential role in reaching the fusion-reaction temperature. (auth)

6629 LASER-PRODUCED PLASMA AND FUSION YIELD. Dzung, L. S. (Brown Boveri and Co., Baden, Switzerland). Z. Angew. Math. Phys.; 23: No. 2, 301-10(1972).

The heating and the expansion of a laser-produced plasma sphere in vacuum environment is investigated under the assumption of a sinusoidal energy absorption rate. Optimum conditions for fusion yield are formulated. The minimum laser pulse strength is determined. It is shown that this minimum energy requirement is still larger by many orders of magnitude than the values attainable today. The appropriate laser pulse length lies in the nanosecond range. (auth)

6630 THEORY OF TURBULENT HEATING OF AN ISOTHERMAL PLASMA WITH A TRANSVERSE CURRENT. Pyatak, A. I.; Sizonenko, V. L. (Physical-Technical Inst., Kharkov). Nucl. Fusion; 12: No. 5, 503-22(Sep 1972).

The excitation of unstable potential oscillations in an isothermal plasma in a strong magnetic field ($H_0^2 \gg 4\pi n_0 m_e c^2$) by means of a current flowing perpendicular to the magnetic field was studied. When the current velocity only slightly exceeds the critical value determining the instability boundary, a nonlinear dispersion equation having a nonlocal form in time is derived for the amplitudes of the unstable oscillations. The authors estimate the energy of the oscillations in a nonlinear regime when the oscillation amplitude ceases to increase due to nonlinear wave interaction. It is shown that the longitudinal temperature of the electrons and the transverse temperature of ions increase at the same rate due to scattering of the plasma electrons and ions by turbulent pulsations of the electric field produced by the unstable oscillations. The effective frequency of ion collisions with these oscillations is found to within an order of magnitude and an estimate made of the maximum temperature which can be attained by the electrons and ions in the regime of the instability under consideration. (auth)

6631 STATIONARY TOROIDAL EQUILIBRIA AT FINITE BETA. Zehrfeld, H. P.; Green, B. J. (Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 12: No. 5, 569-75(Sep 1972).

The effects of plasma flow on axisymmetric, self-consistent equilibria in toroidal geometry are studied. The investigation is of considerable interest in relation to hot plasmas confined in toroidal systems with longitudinal current. On the basis of the one-fluid MHD plasma model, a concise formulation is used to elucidate important features of the equilibrium. In contrast to previous flow calculations which were treated almost exclusively in the low-beta approximation, one retains, together with flow, all beta effects. As in the treatment of the full flow problem at low beta, one finds conditions for equilibrium. The form of the description allows a quite general discussion of its nature and existence for finite beta. This shows that there is a close relationship between the solvability conditions for equations arising

from integrals of the system, and the nature of the characteristics of the partial differential equation describing the radial force balance. In the case of large aspect-ratio, these considerations lead to a generalized Bennett relation and to an expression for plasma displacement exhibiting beta and flow effects. (auth)

6632 INWARD DIFFUSION OF TOKAMAK-TRAPPED PARTICLES BY SLOW MAGNETIC PUMPING. Samain, A. (CEN, Fontenay-aux-Roses, France). Nucl. Fusion; 12: No. 5, 577-85 (Sep 1972).

Particle diffusion in a tokamak configuration under the influence of a very slow magnetic compression wave is studied. The plasma is assumed to be in regime I of Galeev and Sagdeev. The wave interacts irreversibly with trapped particles only and induces a diffusion of these particles. Inward diffusion for a given species takes place if the wave propagates around the major axis faster than the diamagnetic motion of the trapped particles of this species. By using two waves with proper phase velocities, one of which has a preferential coupling with electrons and the other with ions, ambipolar inward plasma diffusion may be achieved. In typical reactor conditions, it is possible to cancel out the neoclassical particle diffusion using magnetic perturbations less than one percent of the static field at frequencies in the kHz-range. (auth)

6633 VISCOSITY DAMPING OF CONVECTIVE CELLS IN J.I.P.P.-STELLARATOR-CONFINED PLASMAS. Fujiwara, M.; Miyamoto, K. (Nagoya Univ., Japan). Nucl. Fusion; 12: No. 5, 587-91(Sep 1972).

The observed distributions of density and floating potential confirm that convective loss plays an important role in plasma transport in the stellarator field. To suppress the convective motion, the effect of viscosity damping of the motion is utilized. As the kinetic viscosity perpendicular to the magnetic field is proportional to $\rho_i^2 \nu_{ii} \propto m_i^{1/2}$ (ρ_i, m_i and ν_{ii} are ion Larmor radius, mass and collision frequency, respectively), heavy ion plasmas such as argon and xenon plasmas are used. The experimental results confirm the effect of the viscosity damping, and the observed diffusion coefficient of the xenon plasma is, within a factor of 2, the same as the neoclassical one in the plateau region. (auth)

6634 RF POWER ABSORPTION OF A PLASMA PRODUCED BY A COAXIAL PLASMA GUN. Masuda, M.; Tanaka, Y.; Okuda, T. (Nagoya Univ., Japan). J. Phys., D (London); 5: No. 9, 1558-60(Sep 1972).

The rf heating of a plasma produced by a coaxial plasma gun is studied. The resonance absorptions at $\omega = \omega_{ce}$ and $\omega = \omega_{ce}/2$ are observed, where ω_{ce} is the electron cyclotron frequency. In the frequency range where $\omega < \omega_{ce}/2$, nonresonant absorption occurs. This may be attributed to the whistler wave mode. (UK)

6635 HEATING OF CHARGED PARTICLES BY ELECTRIC WAVES. Longmire, C. L. (Mission Research Corp., Santa Barbara, Calif.). pp 232-40 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

The collision of two cool plasma clouds with relative velocity such that the kinetic energy of the ions in one cloud with respect to the other is many orders of magnitude larger than the temperatures of ions and electrons in either cloud is studied. Two hydrogen clouds colliding with relative velocity 1% of the velocity of light and with initial temperature 1 eV in each cloud are investigated with respect to resulting instabilities. Heating aspects are described. (M.O.W.)

6636 STOCHASTIC CHARACTER OF ELECTRON CYCLOTRON HEATING IN A NONUNIFORM MAGNETIC FIELD. Kawamura, T.; Namba, C.; Terashima, Y. (Nagoya Univ., Japan). Phys. Fluids; 15: No. 12, 2450-1(Dec 1972).

The rf heating process of electrons in mirrors is thought to be stochastic owing to the nonadiabatic effect before the electron energies reach some critical values. To attain higher energies, other causes of phase radomization should be considered. (auth)

6637 INFRARED-LASER HEATING OF DENSE ARC PLASMAS. Jassby, D. L. (Univ. of California, Los Angeles). Phys. Fluids; 15: No. 12, 2442-4(Dec 1972).

Steady-state dense electric arcs can be heated by the inverse bremsstrahlung process to a temperature of 116 eV with 1 GW 10.6-μ radiation. Rapid thermal conduction limits the maximum temperature. (auth)

6638 THEORY AND SIMULATION OF TURBULENT HEATING BY THE MODIFIED TWO-STREAM INSTABILITY. McBride, J. B.; Ott, Edward; Boris, J. P.; Orens, J. H. (Naval Research Lab., Washington, DC). Phys. Fluids; 15: No. 12, 2367-83(Dec 1972).

Results are presented from an analytical and numerical study of the nonresonant, modified plasma two-stream instability, which is driven by relative streaming of electrons and ions across a magnet field B_0. The instability has characteristic frequency and growth rate comparable to the lower-hybrid frequency. The linear theory is discussed both in the electrostatic and fully electromagnetic cases, and a detailed numerical study of the dependence of the unstable roots of the dispersion relation for a wide range of plasma parameters is presented. The nonlinear theory includes discussions of (1) quasi-linear theory, (2) trapping, which is responsible for nonlinear stabilization, (3) a derivation of a fully nonlinear scaling law which shows how results scale with electron–ion mass ratio, and (4) the effect of cross-field vortex-like motion caused by turbulence induced $E \times B$ drifts. One- and two-dimensional computer simulations with dense k-space spectra are presented in support of this theory. The simulations show that the instability can be a very important turbulent heating mechanism that heats the ions (perpendicular to B_0) and the electrons (parallel to B_0) comparably. The final state has $(T_{i\perp}/m_i)^{1/2} \approx (T_{e\parallel}/m_i)^{1/2} \sim \frac{1}{2}U$, where U is the initial relative drift speed. Applications to experimental situations are discussed. (auth)

6639 NUMERICAL CALCULATIONS OF OFF-RESONANCE HEATING. Sprott, J. C. (Oak Ridge National Lab., TN). Phys. Fluids; 15: No. 12, 2247-53(Dec 1972).

The off-resonance heating that is observed in hot-electron plasmas is explained in terms of harmonic resonances, appropriately modified to include relativistic and Doppler effects. A theoretical expression for the heating rate is proposed and is found to agree with the results of a computer simulation over a range of parameters. The theoretical heating rate is evaluated numerically for several special cases, including a uniform magnetic field, a mirror field with a 2 : 1 mirror ratio, and a large-aspect ratio bumpy torus. The enhanced axial loss observed experimentally with heating below the cyclotron frequency is explained by absorption at harmonics of the electron bounce frequency. (auth)

6640 EFFECT OF FIELD ASYMMETRY ON NEOCLASSICAL TRANSPORT IN A TOKAMAK. Hazeltine, R. D. (Univ. of Texas, Austin); Rosenbluth, M. N. Phys. Fluids; 15: No. 12, 2211-7(Dec 1972).

The effect on transport of a local increase ("bump") in the confining field of a large-aspect-ratio tokamak is studied in the small collision frequency regime, in which trapped particles (particles reflected by the bump) make a dominant contribution. From solution of the drift-kinetic equation with boundary conditions appropriate to trapped and untrapped particles, explicit expressions for the cross-field particle and energy fluxes are obtained; the density, temperature, and potential gradients, and a parallel electric field, are considered as driving terms. While the diffusion and energy fluxes have an easily anticipated form, similar to superbanana transport, the influence of the bump on the Ware flux, resulting from the parallel electric field, is surprisingly large. (auth)

Diagnostics

6641 (AD–741187) MICROWAVE SCATTERING FROM UNDERDENSE AND OVERDENSE TURBULENT PLASMAS. Attwood, D. (New York Univ., N. Y. Dept. of Electrical Engineering). Jan 1972. Contract N00014-67-A-0467-0018. 174p. NTIS.

Experimental results of microwave scattering from turbulent plasma are presented and compared with pertinent theories. For underdense values of mean and fluctuation electron density, scattering is similar to that noted by several other groups, following Born predictions for very weak scattering, and saturating as the critical point is approached. Near the critical point for average electron density, a crossover from volume to surface scattering is observed. For sufficiently overdense values, scattering resembles that from a reflecting surface of appropriate shape and statistics, mean density distribution notwithstanding. Scattering in this latter regime is used as a diagnostic tool to determine the probability distribution function for orientation fluctuations displayed by the overdense thrashing plasma column. (auth) (GRA)

6642 (NP–19595) 337 μm HCN LASER INTERFEROMETER FOR PLASMA DIAGNOSTICS. Heckenberg, N. R.; Tait, G. D.; Whitbourn, L. B. (Sydney Univ. (Australia). School of Physics). Jun 1972. 68p. (ER–67). Dep. NTIS (U. S. Sales Only).

A self-modulating laser interferometer incorporating a 337-μm HCN laser is described, and a simple theory of its operation is developed. This theory shows that the long lifetimes of levels involved in molecular laser transitions may cause a peaked frequency response in such an instrument. Experimental observations indicate a flat frequency response up to the maximum attained fringing rate of 10 kHz. The interferometer was used to make electron density measurements in the range 2×10^{12} cm^{-3} to 10^{14} cm^{-3} for an effective path length of 150 cm in a decaying helium

plasma. The interferograms obtained show a marked variation in fringe amplitude that is attributed to the refractive effects of electron density gradients in the plasma. (auth)

6643 TWO-PHOTON ABSORPTION AND STIMULATED RAMAN SCATTERING ON EXCITED HELIUM ATOMS IN A PLASMA. Burrell, C. F.; Kunze, H. J. (Univ. of Maryland, College Park). Phys. Rev. Lett.; 29: No. 21, 1445-9(20 Nov 1972).

By focusing simultaneously microwave radiation and the beam from a tunable dye laser into a helium plasma, one observes two-photon absorption and stimulated Raman scattering on excited helium atoms. Both effects can be used to measure high-frequency electric fields in plasmas, and the advantages of this method are compared with the standard technique where such fields are investigated in emission spectra. (auth)

6644 METHODS FOR MEASUREMENT OF HOT PLASMAS. Roehr, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Phys. Unserer Zeit; 3: No. 3, 67-73(1972). (In German).

A survey is given of diagnostic methods to determine the relevant plasma parameters such as density, magnetic field, and ion and electron temperatures. The methods described use only "nonmaterial" probes, that means light polarization, scattering and interferometry. (GF)

6645 DETERMINATION OF PLASMA ELECTRON TEMPERATURE FROM REVERSAL OF RADIAL AMBIPOLAR ELECTRIC FIELD IN A LONGITUDINAL MAGNETIC FIELD. Franck, Guenter (OSRAM-Studiengesellschaft, Munich); Held, R.; Pfeil, H. D. Z. Naturforsch.; 27a: No. 10, 1439-43(Oct 1972).

When a longitudinal magnetic field is superimposed to a low pressure plasma, reversal of the radial ambipolar electric field takes place at a definite magnetic field B_r. From the B_r values electron temperatures T_e in the plasma can be found, when classical magnetic field diffusion exists. In the negative H_2- and He-glow plasmas with superimposed longitudinal magnetic field electron temperatures were measured on the one hand by the method of electric field reversal and on the other hand with Langmuir probes. There is a fairly good agreement between the T_e values obtained by both methods. (auth)

6646 SKIN EFFECT AND ELECTRIC CONDUCTIVITY IN AN ARGON PLASMA. Schneider, Helmut; Hugentobler, Edwin (Univ., Fribourg, Switzerland). Helv. Phys. Acta; 45: 611-15 (1972). (In German).

Real and imaginary parts of the electrical conductivity are measured in a decaying argon plasma using skin effect of radio-frequency fields. The finite size of the probe is taken into account. The method is described and results are given. (auth)

6647 PLASMA DIAGNOSTIC MEASUREMENTS IN THE NEGATIVE GLOW OF A CYLINDRICAL HOLLOW CATHODE DISCHARGE. Howorka, F.; Pahl, M. (Univ., Innsbruck). Z. Naturforsch.; 27a: No. 10, 1425-33(Oct 1972). (In German).

The negative glow plasma of a cylindrical hollow cathode dc discharge (0.05 to 1 torr Argon, 1 to 30 mA) was investigated as to the position of the glow edge, the axial dependence of the cathode current density, the axial and radial potential distributions, the density and energy of electrons (from Langmuir probe measurements) as dependent on pressure, discharge current and position, etc. It was found that two groups of electrons exist whose energies are <0.5 eV and ~3 eV and the ratio of their densities being 3 up to 20. A phenomenological explanation is given for the relatively high density of the fast group. The results are compared with those of other authors concerning hollow-cathode and linear discharges. (37 references) (auth)

6648 CHARACTERISTICS OF AN ARGON rf PLASMA: ACTIVE DISCHARGE AND LAMINAR SONIC FLOW REGION. Medgyesi-Mitschang, L. N.; Hefferlin, R. A. (McDonnell Douglas Corp., St. Louis). J. Quant. Spectrosc. Radiative Transfer; 12: No. 12, 1627-39(Dec 1972).

Electron density, excitation, and gas temperatures were obtained from optical spectrometric, microwave interferometric, and thermocouple measurements in an argon rf plasma. The investigation was carried out in an active discharge and a channel region characterized by sonic laminar flow. Optical measurements of the excitation temperature were made in the 4000 to 5000 Å range for discharge pressures of ~63 to 644 torr and input rf power of 42 to 60 kW. Excitation temperatures in the discharge ranged between ~7000 to 10,000 K. Electron densities measured by optical and microwave techniques showed good agreement. Thermocouple measurements in the channel and N_2 rotational spectra from traces of N_2 injected in the argon, as well as gas dynamic considerations, indicated that the gas temperature in the discharge and the channel regions were 2900 to 4400 K and 1900 to 3300 K, respectively. These values were substantially lower than the excitation temperatures corresponding to these regions, indicating that the plasma was in a two-temperature state in both regions. Standard tests for local thermal equilibrium (LTE) showed that the first excited level of argon constituted the bottleneck level. (auth)

6649 ION-PROBE CURRENT IN A MAGNETIZED PLASMA. Sato, Masumi (Yamagata Univ., Yonezawa, Japan). Phys. Fluids; 15: No. 12, 2427-33(Dec 1972).

Current–voltage characteristics of Langmuir probes in a strong magnetic field are presented. The experiments were performed using argon or helium gases with pressure 0.1 to 5.6 mtorr and the plasma density ranging from 10^{11} to 10^{12} cm^{-3} for the field 1 to 5.5 kG. It is found that (1) for electron collection a cylindrical probe behaves like a disk; (2) the ion retardation part becomes unmasked over positive potentials as a result of decreased electron current; (3) the slope of its logarithmic plot gives the ion temperature; and (4) its values (nearly equal to the electron temperatures of 0.3 to 1.5 eV) derived from the slope seem to be the true temperatures. Errors and limiting conditions for the determination of ion temperatures are discussed. (auth)

6650 ELEVATED ION TEMPERATURE IN A DOUBLE-ENDED Q MACHINE. Brown, I. G. (Max-Planck-Institut fuer Plasmaphysik, Munich). Phys. Fluids; 15: No. 12, 2254-9(Dec 1972).

The perpendicular ion temperature of a barium plasma contained in a double-ended Q machine was measured by a spectroscopic technique. When the plasma is "ion-rich," good agreement is found between the measured ion temperature and the hot-plate temperature, while in the "electron-rich" regime, the ion temperature is elevated above the hot-plate temperature. The increased ion temperature can be well accounted for by the energy input through the acceleration of ions through the electron sheath and their consequent thermalization. (auth)

6651 SCATTERING OF LIGHT BY RELATIVISTIC ELECTRONS. Ward, Gray; Pechacek, R. E. (Univ. of Maryland, College Park). Phys. Fluids; 15: No. 12, 2202-10(Dec 1972).

The differential scattering cross section for the interaction of optical photons with relativistic electrons is calculated from quantum electrodynamics. The cross section is confirmed by scattering monochromatic electromagnetic radiation from 50-keV electrons. The classical calculation of the differential scattering cross section which agrees with the quantum electrodynamic calculation and with experiment is one which takes into account the fact that scattering electrons enter and leave the scattering volume during the period of observation. These results are important for the proper interpretation of laser scattering measurements of plasma distribution functions when electron temperatures are ≥10 keV. (auth)

Kinetics (General)

Refer also to abstracts 5802 and 5803.

6652 (AD–741869) EXPERIMENTAL MEASUREMENTS OF FORCE-FREE COLLINEAR PLASMOIDS PRODUCED BY A CONICAL THETA PINCH. Nolting, E. E. (Miami Univ., Coral Gables, Fla. Dept. of Physics). Aug 1971. 213p. (AFOSR-TR–71-2905). NTIS.

A discussion of an experimental study performed on the TRISOPS plasma device is given. The TRISOPS experiment uses two conical theta-pinch guns to heat the plasma. A brief history of the theoretical principles on which the experiment is based is presented, followed by a discussion of the experimental work. This work is divided into three parts. The first part constitutes a detailed description of the experimental device. Experimental parameters are investigated and the effect of these parameters on the plasma is described. The second part contains the study of plasma produced by a single gun. Strong experimental evidence is given to support a force-free, collinear plasma theory. The third part presents the results of studies of colliding plasmoids. Experimental evidence of a deep magnetic well in the external guide field, formed by currents flowing in the plasma, is given. The size of the well as a function of experimental parameters is discussed. Use of the force free, collinear model in discussing the observed interaction supports the model. (auth) (GRA)

6653 (AD–741913) EXPERIMENTAL STUDY OF FORCE-FREE, COLLINEAR PLASMA STRUCTURES. Nolting, E. E.; Jindra, P. E.; Wells, D. R. (Miami Univ., Coral Gables, Fla. Dept. of Physics). May 1972. 33p. (MIAPH-PP–72-2; AFOSR-TR–72-1040). NTIS.

Detailed measurements of the trapped magnetic fields and currents in plasma structures generated by conical theta pinches are reported. Studies of these structures interacting with a mag-

netic barrier, and with each other in a collision at the center of a magnetic mirror, are reported. The magnetic well formed by the collision was studied by simultaneous use of several diagnostic techniques. The measurements are in agreement with a force-free, collinear magnetic field configuration (Wells, 1972). Arguments relating superposability and collinearity of flow fields to these observations are given. (auth) (GRA)

6654 STRUCTURE OF EXPONENTIAL SPECTRA OF RELATIVISTIC ELECTRONS IN A TURBULENT PLASMA. Tsytovich, V. N.; Chikhachev, A. S. Sb. Statei Mosk. Inzh.-Fiz. Inst.; No. 3, 97-103(1971). (In Russian).

In previous articles the authors considered the problem of the acceleration of relativistic electrons in a turbulent plasma during their interaction with electromagnetic radiation. It was shown that the solution of the self-consistent problem for waves and electrons gives an exponential energy spectrum $\sim 1/\epsilon^{\gamma}$ for electrons with the exponent γ, which is a function of the ratio κ of the plasma energy density W to the plasma particle energy density, $\kappa = W/n_0mc^2$, and the ratio ξ of the gyrofrequency $\omega_{He}^{(0)} = eH/mc$ to the plasma frequency $\omega_{pe} = \sqrt{4\pi ne^2/m_e}$, $\xi = eH/mc\omega_{pe}$. These spectra are generated only up to those maximum energies whose values are determined from radiation cutoff conditions. The acceleration of relativistic electrons is due to the action of magnetic breaking and plasma mechanisms. The relation between particle energy and frequency is different for these two mechanisms. It is known that inflection points are observed in most spectra of radiation sources. They can be explained by changes resulting from energy losses due to the radiation of relativistic electrons in the propagation of electrons from a generation source. From considerations concerning the two acceleration mechanisms, it follows that there is also another possibility, involving the fact that during particle acceleration inside the sources the above-indicated inflection points are formed in the spectra of the accelerated particles, and spectra of this kind are injected in the space outside the sources. The present article is devoted to an analysis of this question. It is shown that the particle spectra most often are not exponential but are close to exponential. This corresponds to observed results. In view of this, great interest attaches to the numerical solution of the spectra problem without the use of strong inequalities, which the authors are forced to use in the present article. (JPRS)

6655 ADIABATIC COMPRESSION OF THE TOKAMAK DISCHARGE. Bol, K.; Ellis, R. A.; Eubank, H.; (and others) (Princeton Univ., N. J.). Contract AT(11-1)-3073. Phys. Rev. Lett.; 29: No. 22, 1495-8(27 Nov 1972).

A tokamak discharge of $T_e \sim 1$ keV is produced in the absence of conducting-wall magnetohydrodynamic stabilization, and then compressed in major radius by a factor of 2.3 in a static toroidal field. Measurements are reported on the resultant rise of density, temperature, and plasma current. (auth)

6656 HYDROGEN CLUSTERS FOR NUCLEAR FUSION. Nachr. Chem. Tech.; 20: No. 12, 229-30(1972). (In German).

A short survey is given of the basic mechanisms governing the injection of submicroscopic (solid or liquid) particles into a nuclear fusion device: adiabatic expansion from nozzles at 20 to 30 K, separation from noncondensed gas, ionization, energy distribution, breakup of clusters and acceleration. (GF)

6657 CATHODE FALL IN A CYLINDRICAL HOLLOW CATHODE. Helm, H.; Howorka, F.; Pahl, M. (Univ., Innsbruck). Z. Naturforsch.; 27a: No. 10, 1417-25(Oct 1972). (In German).

The electric field distribution in the cathode fall and the current–voltage characteristic of a cylindrical hollow cathode are calculated on a purely radial model. The theoretical characteristic is compared with results measured on a H_2 and Ar discharge. From the experimental data, the current density ratio of electrons and ions on the cathode can be calculated. This ratio appears in the correct order of magnitude only if the carrier generation in the cathode fall is taken into account. Comparisons are made with the results of linear theories. (auth)

6658 PLASMA DENSITY FLUCTUATIONS IN THE PRESENCE OF OPTICAL MIXING OF LIGHT BEAMS. Meyer, J. (Univ. of British Columbia, Vancouver). Phys. Rev., A.; 6: No. 6, 2291-7(Dec 1972).

The density-fluctuation spectrum and wave-vector distribution are calculated for a plasma subjected to the influence of two intense laser beams. The influences of the plasma ions, a possible external uniform magnetic field, the spectral intensity distribution of the mixed laser beams, and their finite diameter are taken into account. The spectrum is shown to consist of two contributions, of which one is recognized as the thermal-fluctuation spectrum while the other is induced by a force generated by the mixed laser beams. Both contributions simply add as a result of the incoherent nature of the thermal fluctuations. It is shown that the theoretical results are in agreement with recent experimental observations. Special attention is also directed to the case in which two beams, generated by the same laser, are mixed in a plasma, and it is shown that enhancement of the ion feature in the spectrum of more than two orders of magnitude against the thermal case can be produced by employing common Q-switched ruby lasers. (auth)

6659 TRANSIENT BEHAVIOR OF PLASMA CYLINDERS AT MAGNETO-ACOUSTIC RESONANCE. Appert, K.; Hoegger, B.; Schneider, H.; Weise, E. (Univ., Freiburg, i. B.). Helv. Phys. Acta; 45: 533-6(1972). (In German).

The transient behavior of an oscillating plasma cylinder is studied near magneto-acoustic resonance. Appropriate nonlinear magnetohydrodynamic equations are solved as an initial-value problem, and the results are compared with experiments. The energy absorbed in the plasma is found to be strongly dependent on transient effects. (auth)

6660 X-RAY FINE STRUCTURE OF DENSE PLASMA IN A CO-AXIAL ACCELERATOR. Bostick, W. H.; Nardi, V.; Prior, W. (Stevens Inst. of Tech., Hoboken, NJ). J. Plasma Phys.; 8: No. 1, 7-20(Aug 1972).

The intensity of x-ray sources in a focused deuterium plasma produced by a coaxial accelerator was analysed as a function of position, x-ray energy, and time of emission. The x-ray source in the axial region was resolved as a sequence of small sources of hard radiation $\approx$2 keV inside a more diffused source of softer x rays. In each discharge the point sources were distributed for the most part in the general axial region of the discharge and two or more sources with different radial positions were frequently observed for one specific value of the axial coordinate. The source multiplicity can be related to a complex (filamentary) structure of the plasma. (auth)

6661 CURRENT SHEATH STUDIES IN A CO-AXIAL PLASMA FOCUS GUN. Chow, S. P.; Lee, S.; Tan, B. C. (Malaya Univ., Kuala Lumpur). J. Plasma Phys.; 8: No. 1, 21-31(Aug 1972).

A coaxial plasma focus device was operated in deuterium gas at ambient pressures from 0.2 to 0.7 mm Hg and condenser bank voltages from 10 to 22 kV. Magnetic probing revealed an axisymmetric parabolic current sheath which propagated down the coaxial tube (steady propagation region) and collapsed off the end of the coaxial gun forming a dense plasma focus. The state of the plasma just before the focusing action was very much dependent on the velocity in the steady propagation region. This velocity was experimentally studied and compared with a snow-plough theory. The collapsing phase of the current sheath was studied using high-speed framing photography and current and voltage measurements. The results indicate a focus of length 1.5 cm and radius less than 1.7 mm. (auth)

6662 DIFFUSION CONTROLLED BREAKDOWN OF GASES IN A RECTANGULAR MICROWAVE CAVITY. Maldonado, C. D.; Ayala, I. L. (North American Rockwell Corp., Anaheim, CA). J. Plasma Phys.; 8: No. 1, 67-75(Aug 1972).

The boundary-value problem for diffusion-controlled breakdown of gases in microwave cavities is converted to a variational principle for the square of the reciprocal of the "effective" diffusion length. For a rectangular cavity the resultant variational principle was minimized by an iterative-variational procedure. This was done using a high-frequency ionization coefficient. The resultant hierarchy of approximations is applied to the TE_{110} and TE_{220} modes of excitation. Adequate convergence is obtained with the first six approximations. Resultant plots of the ratio of the "effective" to the characteristic diffusion length for various ratios of longitudinal to effective transverse cavity dimensions, imply that diffusion loss is greater for the TE_{220} mode of excitation. Also, from this theoretical investigation it is felt that the first ten approximations to the variational principle should provide adequate convergence for most situations encountered in practice. (auth)

6663 HYDROMAGNETIC FLOW ABOUT A CURVED NEUTRAL SHEET. Teske, M.; Lam, S. H. (Princeton Univ., NJ). J. Plasma Phys.; 8: No. 1, 77-95(Aug 1972).

The magnetic boundary layer along a curved interface between two opposing fluid streams carrying oppositely directed magnetic fields is examined. A formal two-dimensional theory is constructed that depends solely on the mechanism of magnetic diffusion and thus eliminates the need for any added MHD waves. The detailed structure of the neutral sheet boundary layer and the parametric dependence of the solution on free-stream parameters such as the magnetic Reynolds number and the Alfvén number is shown. A thin, powerful jet of high thermal and kinetic energy is shown to exist within the boundary layer. Some numerical solutions are presented and the various mathematical difficulties associated with this class of problems are discussed. (auth)

6664 INTERMITTENT BEHAVIOR OF A PLASMA DISCHARGE IN A TURBULENT GAS FLOW. Levine, A. M. (Richmond Coll., Staten Island, NY); Granatstein, V. L.; Rhinewine, M. Phys. Fluids; 15: No. 12, 2231-9(Dec 1972).

A new model to describe an arc discharge struck in a turbulent pipe flow is discussed. In this model, a randomly twisted column is convected down the pipe producing an intermittent signal on electrostatic probes. A theoretical and experimental analysis of these signals is presented. The analysis provides information about discharges in rapidly flowing gases and also develops techniques useful in studying intermittent phenomena. (auth)

Kinetics (Experimental)

6665 (AEC-tr-7373) NONTHERMAL EMISSION OF A MAGNETOACTIVE PLASMA IN THE FIELD OF A SUPERHIGH FREQUENCY PUMPING WAVE. Batanov, G. M.; Sarksyan, K. A. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). Translated from report NP-19255. 9p. Dep. NTIS.

An experimental study was made of superhigh frequency emission of a collisionless magnetized plasma on its interaction with a powerful pumping wave in the microwave range. In the emission spectrum on the first harmonic of the pumping wave ω_0, red and blue satellites were detected which were shifted with respect to the central peak by $\Delta\omega \sim \omega_{Li}$; ω_{Li} is the ion Langmuir frequency which indicates the buildup of the most shortwave ion oscillations. Emission was detected on the second harmonic of the pumping wave $2\omega_0$, the intensity of which increases exponentially with an increase in the power of the incident wave. On interaction of the plasma with the powerful wave with a frequency ω_0, nonlinear intensification of the weak signals with frequencies close to $2\omega_0$ was observed. The observed effects of excitation of the satellites and emission on the second harmonic of the pumping wave correlate with the effects of anomalous absorption and heating, and they are explained by parametric excitation of the plasma oscillations. (auth)

6666 (AEC-tr-7388) R-OM EXPERIMENTAL SETUP FOR STUDYING THE INTERACTION OF HIGH-FREQUENCY FIELDS WITH A PLASMA. Demirkhanov, R. A.; Kirov, A. G.; Mayburov, V. B.; Rakhel'kin, A. Z.; Savchenko, I. S.; Stotland, M. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Sukhumi. Fiziko-Tekhnicheskii Institut). Translated from report NP-18801. 62p. Dep. NTIS.

The physical considerations underlying the development of the "R-Om" setup are presented, its design is described, the quasiconstant and high-frequency magnetic fields are calculated, the design of the high-frequency system is given, and the parameters of the setup are obtained. (auth)

6667 SPECTROSCOPIC INVESTIGATION OF TURBULENT PLASMA PARAMETERS. Berezin, A. B.; Dubovoi, L. V.; Lyublin, B. V.; Yakovlev, D. G. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 750-4(Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 946-52(May 1972).

The electrical fields in the turbulent plasma of a high-frequency z discharge are calculated for high-frequency $|\alpha_s|\sqrt{\langle E^2\rangle} \ll \Omega$ and low-frequency $|\alpha_s|\sqrt{\langle E^2\rangle} \gg \Omega$ electric fields. Here, $|\alpha_s|\sqrt{\langle E^2\rangle}$ is the Stark shift, and Ω is the frequency of the electric field. The turbulent microfields are estimated by measuring the profile of the H_β line in hydrogen. Satellites on the line wings at a distance $\simeq \omega_{pe}$ from the line center have been detected. Expressions for the electric fields for branches are given. The experimentally determined field E is 6 kV·cm^{-1} for the low-frequency branch and 5.5 kV·cm^{-1} for the high-frequency branch. The frequency of the high-frequency turbulent electric field, determined from the satellite shift relative to the line center, is $\simeq 9 \times 10^{11}$ sec^{-1}. The plasma turbulence level $\epsilon = E/8\pi nT \simeq 10^{-4}$. The values of the anisotropy $E_\parallel/E_\perp$, determined experimentally by measuring the broadening of the hydrogen lines along and across the axis and on the basis of polarization measurements, are in good agreement, and are $\simeq 3$. (auth)

6668 HIGHLY IONIZED GAS DISCHARGE. Sakharov, I. E.; Tsendin, L. D. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 727-30(Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 916-20(May 1972).

The properties of the plasma in a high-current pulsed discharge in Ar with ionization close to 100% are investigated. The electron temperature and longitudinal electric field increase as the discharge current increases. The parameters of the plasma column depend strongly on the mechanism by which ions and atoms interact with the walls. At pressures of the order of 10^{-2} mm Hg, T_e values of ~20 eV and a degree of ionization close to unity are achieved. The volt-ampere characteristics of the discharge agree with the theoretical predictions. (auth)

6669 ELECTRON-NEUTRAL PARTICLE ELASTIC INTERACTION IN ARGON IN THE VICINITY OF THE RAMSAUER MINIMUM. Delpech, J. F.; Sol, Charles (Paris Univ., Orsay, France). Compt. Rend., Ser. B; 275: No. 4, 183-6(24 Jul 1972). (In French).

The microwave diagnostics method was used to measure the electron-neutral collision frequency in an argon afterglow plasma, at electron temperature between 300 and 4500 deg K. The σ_{MT} cross section for the momentum transfer was deduced; at the Ramsauer minimum, $\sigma_{MT} = 1.7 \times 10^{-17}$cm^2 and $kT_e = 0.25$ eV. (France)

6670 EXPERIMENTAL STUDY OF A CONTINUOUS FLOW PINCH. Prinn, A. E.; Ricketts, B. W. (Univ. of Liverpool). J. Phys., D (London); 5: No. 11, 2026-36(Nov 1972).

A continuous flow pinch formed in a coaxial plasma device with pulsed gas admission was investigated. Maximum temperatures of 50,000K and densities of 3×10^{17} cm^{-3} were measured spectroscopically during the 40-μs stable lifetime of the pinch. The properties of the low-β plasma which was formed in the interelectrode space of the device have been determined and used to calculate the degree of compression which occurred beyond the end of the centre electrode. The number density/compression ratio was found to be 25, and the temperature was increased by a factor of 3.5. An approximate energy balance for the flow process has been established using measured values of the speed of flow of the plasma before and after compression. (auth)

6671 OBSERVATION OF ROTATIONAL DISTURBANCES IN A THETA-PINCH PLASMA. Masuzaki, M.; Tsuzuki, T. (Nagoya Univ., Japan). J. Phys., D (London); 5: No. 11, L105-7(Nov 1972).

Rotational disturbances in a theta-pinch plasma have been observed with magnetic pick-up loops placed outside the vacuum vessel. The observed disturbances have short wavelengths and their frequencies are slightly lower than the ion cyclotron frequencies. (auth)

6672 CURRENT DISTRIBUTION AND MASS PICKUP DURING A HOLLOW DYNAMIC PINCH DISCHARGE IN CONDENSED MOLECULAR BEAMS OF NITROGEN. Becker, E. W.; Klingelhoefer, R.; Wuest, J. (Univ., Karlsruhe, Ger.). Z. Naturforsch.; 27a: No. 10, 1406-9(Oct 1972). (In German).

The current distribution during a z-pinch discharge in a hollow cylindrical beam of nitrogen clusters is determined by magnetic probe measurements. After breakdown, a current sheath arises within the ring-shaped cross section of the cluster beam. During the discharge the sheath is accelerated radially inward towards the axis. Simultaneously the radial collapse of a hollow luminosity pattern is observed by image converter photographs. The arrival of the current sheath at the axis coincides with the rapid development of a luminous core in the photographs. The radius-time curve of the sheath is calculated with the measured density of the electrodynamic forces neglecting pressure terms. Comparison of the observed and the calculated radius-time curves seems to indicate that most of the injected mass of the cluster beam is swept inward by the pinch discharge. (auth)

6673 MEASUREMENT OF CONTINUUM RADIATION FROM AN ARGON PLASMA. Ghosh Roy, D. N.; Tankin, R. S. (Northwestern Univ., Evanston, IL). J. Quant. Spectrosc. Radiative Transfer; 12: No. 12, 1685-99(Dec 1972).

The continuum radiation of atmospheric argon plasma generated by a free burning arc was investigated over the spectral range of 1000 to 9000 Å. The validity of the Kramers-Unsöld model for the continuum radiation is investigated, and Biberman's ξ functions are obtained and compared with theory. The experimental technique used in this study required only relative intensity measurements. (auth)

6674 SPATIAL DISTRIBUTIONS OF PLASMA DENSITY IN A HIGH-FREQUENCY DISCHARGE WITH A SUPERIMPOSED STATIC MAGNETIC FIELD. Szuszczewicz, E. P. (Goddard Space Flight Center, Greenbelt, MD). Phys. Fluids; 15: No. 12, 2240-6(Dec 1972).

An experimental investigation was carried out on the spatial distribution of charged-particle density in an inductively-coupled, cylindrical high-frequency plasma discharge with a superimposed perpendicular magnetic field. The studies were performed at and near conditions of electron-cyclotron-wave resonance and consideration was given to the influence of magnetic field and high-frequency power levels. It is shown that high-frequency power levels have relatively little influence on the volume distribution of charge, but that very unique distributions result under conditions of electron-cyclotron-wave resonance. Characteristic distributions are presented and discussed in the context of plasma anisotropy resulting from the superimposed magnetic field. (auth)

6675 SPECTROSCOPIC OBSERVATIONS OF TURBULENCE IN A FAST THETA PINCH. Davis, W. D. (Univ. of Maryland, College Park). Phys. Fluids; 15: No. 12, 2383-90(Dec 1972).

The spectrum of fluctuating fields in a collisionless magnetized plasma produced in a high-voltage theta pinch is studied, using satellite line techniques. Differences in the turbulent spectrum exist depending on whether the initial magnetic field is parallel or antiparallel to the driving magnetic field with the possible identification of electron cyclotron modes in the antiparallel case and electron plasma oscillations in the parallel case. By including quadratic Stark shifts, difficulties in interpretation of an earlier satellite experiment are explained. Predictions of various instability theories are tested experimentally with the aid of additional diagnostic methods. (auth)

Kinetics (Theoretical)

6676 (AEC-tr-7376) STUDY OF DENSITY FLUCTUATIONS OF THE L-I STELLARATOR BY THE CORRELATION METHOD. Berezhetskii, M. S.; Grebenshchikov, S. E.; Kossyi, I. A.; Sbitnikova, I. S.; Shpigel, I. S. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). Translated from report NP-19257. 27p. Dep. NTIS.

The spectral and space-time characteristics of the density and electric field fluctuations and also their dependences on the magnitude of the magnetic field intensity and the angle of rotational transformation of the lines of force were studied. Determination of the indicated characteristics of the fluctuations combined with knowledge of the basic plasma parameters permitted identification of the type of excited oscillations on the basis of the existing theoretical concepts and indication of the possible buildup mechanisms and the effects leading to stabilization. (M.O.W.)

6677 (AEC-tr-7382) DEVELOPMENT OF THE CONCEPT OF PLASMA TURBULENCE. Tsytovich, V. N. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). Translated from report NP-19167. 45p. Dep. NTIS.

The analysis performed here demonstrates that now there is a successive and complete picture of the physical processes in a turbulent plasma although, of course, an entire series of specific problems requires further calculations, for example, correlation broadenings for various oscillations in the external field, the structure of turbulent spectra, electromagnetic properties of a turbulent plasma, and so on. The significance of the method of elementary excitations is becoming more and more clear. On the one hand it receives good grounds from the direct calculations considering turbulent collisions and, on the other hand, being very clear and simple, it can be used to check the various refinements of the theory. Thus, a number of them give corrections that are beyond the limits of accuracy of the method of elementary excitations. Finally, for this survey, it is emphasized that the concept of effective turbulent collisions, important to the construction of the general theory, has numerous applications and is important for the comparison of the theoretical results with the results of the observations. The concept of effective turbulent collisions held throughout the review can be of assistance to experimenters for clear qualitative interpretation of processes in a turbulent plasma and to theoreticians for clearly distinguishing the turbulent elementary excitations that describe the states close to statistical equilibrium. (auth)

6678 (COO-2007-25) MONTE CARLO SIMULATION OF NONLINEAR RADIATION INDUCED PLASMAS. Wang, B. H. (Illinois Univ., Urbana). May 1972. Contract AT(11-1)-2007. 160p. Dep. NTIS.

Thesis.

A Monte Carlo simulation model for radiation induced plasmas with nonlinear properties due to recombination was developed, employing a piecewise linearized predict-correct iterative technique. Several important variance reduction techniques were developed and incorporated into the model, including an antithetic variates technique (negatively correlated variates) which has proven to be most useful. This approach is especially efficient for plasma systems with inhomogeneous media, multidimensions, and irregular boundaries, where other analytic or numerical solutions are either unrealistic or impractical. This model is quite general in scope and should be applicable to a variety of similar particle transport and diffusion-type plasma problems. The Monte Carlo code was applied to the determination of the electron energy distribution function and related parameters for a noble gas plasma created by α-particle irradiation. The calculations were specifically carried out for a helium gas medium with an electron source rate from 10^{14} to 10^{22} (#/cm^3-sec), initial electron energies from 70 to 1000 eV, pressures from 10 to 760 torr, and E/P (electric field/pressure) ratios from 1 to 10 V/cm-torr. (auth)

6679 ELECTRON ANGULAR DISTRIBUTION IN A PLASMA WITH A RETARDING POTENTIAL. Baksht, F. G.; Ivanov, V. G.; Moizhes, B. Ya. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 731-6(Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 921-4(May 1972).

The electron angular distribution in a plasma is calculated at a collector with a retarding potential in the sheath for the case in which the energy relaxation length for the electrons is large in comparison with the mean free path. The kinetic equation for the electron angular distribution function is solved by the Gaussian mesh-point method. The problem then reduces to a system of first-order linear differential equations, which are then solved numerically. The electron angular distribution function is calculated both at the electrode boundary and within the plasma volume. (auth)

6680 INJECTION OF AN ELECTRON BEAM INTO A PLASMA CONFINED BY A CONDUCTING SHELL. Rosinskii, S. E.; Rukhadze, A. A.; Rukhlin, V. G.; Epel'baum, Ya. G. (Lebedev Inst. of Physics, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 737-43(Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 929-38(May 1972).

One of the most interesting aspects of the injection of an electron beam into a plasma is the magnetic neutralization of the beam due to the reverse plasma current induced in the plasma. This phenomenon makes possible the flow of superlimiting currents in the plasma-filled drift region. In an analysis of the injection of a radially inhomogeneous electron beam into a plasma confined by a conducting shell it is shown that the spatial inhomogeneity of the beam gives the magnetic neutralization a volume nature: The reverse plasma current is partially balanced by the magnetic field of the current over the entire beam cross section. On the other hand, the conducting shell has essentially no effect on the magnetic neutralization of the beam; the only effects are slight quantitative changes in the theory for the injection of an electron beam into a spatially unconfined plasma. (auth)

6681 TRANSPORT COEFFICIENTS OF A NON-LORENTZIAN PLASMA. Petit, J. P. (Univ. Aix-Marseille). J. Mec.; 11: No. 2, 233-50(Jun 1972). (In French).

In the resolution of the Boltzmann equation, the use of an iterative procedure is shown to involve a basic assumption about the dominant process, other processes being treated as perturbations. According to this point of view the Chapman-Enskog method gives priority to the collisional process. An iterative system giving priority to the electron-heavy particle collisions is presented to third order, and the solution provides a non-Lorentzian analysis of the transport problem. This theory is extended to a nonequilibrium case ($T_e > T_g$). (France)

6682 PLASMA OSCILLATION EFFECT ON THE PROCESS OF IONIZATION RELAXATION. Kogan, E. Ya.; Fisun, O. I. (Inst. of Electrodynamics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 9, 1482-7(Sep 1972). (In Russian).

The problem of atomic system redistribution by excited states is considered under conditions when the oscillations are excited in plasma. The direct absorption effect of transverse quanta of plasma oscillations (plasmons) is taken into account in diffusion approximation. (auth)

6683 ION VELOCITY DISTRIBUTION OF A WEAKLY IONIZED GAS IN A UNIFORM ELECTRIC FIELD OF ARBITRARY STRENGTH. Whealton, J. H.; Woo, S. H. (Univ. of Delaware, Newark). Phys. Rev., A.; 6: No. 6, 2319-25(Dec 1972).

The velocity-distribution function of ions in a neutral gas is studied. A uniform electric field of arbitrary strength is assumed and only binary-ion-neutral-particle collisions are considered. Under these conditions part of the Boltzmann-equation collision operator is replaced by a kinetic model which enables the ion velocity distribution to be found in compact analytical form if the mean free time between ions and neutrals is independent of velocity. This velocity distribution exhibits the expected properties of drift, elevated ion temperature (as compared to the neutral gas), and skewness in the field direction. In addition, the velocity distribution obtained agrees with the known distributions in the extreme cases of (a) low fields and arbitrary masses and (b) arbitrary fields but extremely disparate ion and gas masses. Other tests are made for this distribution with satisfactory agreement. (auth)

6684 OFF-DIAGONAL MATRIX ELEMENTS IN THE STARK-BROADENING THEORY OF NEUTRAL LINES IN PLASMAS. Deutsch, C. (Univ., Paris); Sassi, M.; Coulaud, G. Phys. Rev., A.; 6: No. 6, 2484-5(Dec 1972).

The various proposals made for the evaluation of the second-order matrix elements of the electron-collision operator of partially degenerate lines are compared numerically for the He I 4471-Å line emitted from a thermal plasma. No significant

discrepancy is found. An interpretation of this result is given. (auth)

6685 CONTINUUM RADIATION FROM NONISOTHERMAL HYDROGEN PLASMAS. Nelson, H. F.; Wang, C. Y. (Univ. of Missouri, Rolla). J. Quant. Spectrosc. Radiative Transfer; 12: No. 12, 1593-1608(Dec 1972).

An account is presented of an investigation of the continuum radiative flux from nonisothermal stagnation shock layers composed of a hydrogen plasma. The general equations for the composition are derived and the Rankine–Hugoniot equations are simplified and solved to give the thermodynamic conditions in the shock layers. The radiative flux is calculated by considering ground to free state radiative transitions in atomic hydrogen for conditions roughly representing those of a space probe entering Jupiter's atmosphere. The influence of Mach number, ambient density (altitude), spectral variation of the radiation absorption coefficient, shock-layer thickness, excited state radiation, and temperature profiles are examined. The results show that not only the composition but also the equilibrium temperature behind the shock wave is essentially determined by considering only the ground state of atomic hydrogen. The excited state is largely responsible for the emitted radiation near the shock where the temperature is high, while the ground state produces the radiation in the cooler region of the shock layer near the body. In addition it is shown that the temperature profile is very important in determining the radiative flux reaching the body. The isothermal approximation not only overestimates the radiative flux but also influences the spectral distribution of the radiation reaching the body. (auth)

6686 ESTIMATE OF RADIATIVE EMISSION FROM AN ISOTHERMAL XENON PLASMA AT TEMPERATURES UP TO 50,000°K. Kobayashi, Y.; Nerem, R. M. (Ohio State Univ., Columbus). J. Quant. Spectrosc. Radiative Transfer; 12: No. 12, 1647-57(Dec 1972).

An estimate of radiative emission from an isothermal slab of an equilibrium xenon plasma was carried out for a range of temperatures from 10,000 to 50,000°K, pressures of 0.1, 1.0 and 10.0 atmospheres, and slab thickness ranging from 0.1 to 10 cm. Xe I to Xe V were included and both line and continuum radiation processes were taken into account. The results obtained indicate that the emission is dominated by line radiation with the vacuum-uitraviolet lines being strongly self-absorbed. Fluxes are calculated to be as high as 1 MW/cm^2 at 50,000°K. These results are used to assess the importance of radiative cooling behind incident shock waves in xenon. Comparisons with similar calculations for hydrogen plasmas are made. (auth)

6687 REFORMULATION OF QUASI-LINEAR THEORY. Kaufman, A. N. (Univ. of California, Berkeley). J. Plasma Phys.; 8: No. 1, 1-5(Aug 1972).

A new formulation of quasi-linear theory is presented, which allows for only resonant diffusion, caused by both growing and damped waves. Nonresonant terms do not appear in the diffusion equation, but contribute to wave momentum and energy, and ensure conservation of total momentum and energy. (auth)

6688 SELF-CONSISTENT ROTATING ELECTRON SYSTEM. Kjellmert, B. (Inst. of Physics and Tech., Uppsala). Physica; 61: No. 3, 426-42(1 Oct 1972).

An electron plasma is considered where all electrons rotate about an axis parallel to an external magnetic field. Fields and densities are assumed to depend only on the distance from the axis of rotation. The plasma is assumed to be cold and the Maxwell equations and the Newton equation are used to treat the problem, using the relativistic mass factor as a parameter. The resulting self-consistent solutions also describe a very thin layer, a shell, consisting of ultrarelativistic electrons. The shell radius is shown to be determined by the total number of electrons, the total angular momentum, the external magnetic field and the corresponding quantities in an initial system. Moreover, a criterion is formulated that indicates what shells of this type constitute minimum-energy systems. Due to this criterion it is found that some shells (but not all) correspond to a minimum. (auth)

6689 NONLINEAR OSCILLATION DEVELOPMENT DURING INTERACTION OF A MODULATED ELECTRON BEAM WITH PLASMA. Rogashkova, A. I.; Kharchenko, I. F.; Tseitlin, M. B.; Tsitson, I. T. (Inst. of Radio Tech. and Electronics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 8, 1121-31(1972). (In Russian).

The interaction of the velocity-modulated electron beam with longitudinal waves in plasma in the nonlinear regime was investigated. The phase trajectories of an electron beam, the electron velocity distribution function, the field amplitudes of a spatial charge, and the electron velocities in the phase at different stages of interaction were determined. (auth)

6690 BOUNDARY FLUCTUATIONS OF A PLASMA FILAMENT WITH CURRENT. Selidovkin, A. D. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 8, 1155-61(1972). (In Russian).

In the hydrodynamic approximation, an equation is derived for the average square of the boundary displacement (or the field perturbation value at the boundary) of a plasma cord with the longitudinal current in the external homogeneous magnetic field near the plasma instability threshold. The effects of the finite value of plasma and sheath conductivity, as well as Landau damping, on the maximum fluctuation value are evaluated. (auth)

6691 PHOTON REST MASS AND ENERGY TRANSPORT IN COLD PLASMAS. Burman, R. (Western Australia Univ., Nedlands). J. Phys., A (London); 5: No. 11, L128-30(Nov 1972).

The energy densities and generalized Poynting vectors for longitudinal and transverse waves in cold plasmas are investigated. (auth)

Production

Refer also to abstract 6629.

6692 (AEC-tr-7372) SOME CHARACTERISTIC FEATURES OF THE FORMATION OF A MICROWAVE DISCHARGE PLASMA IN THE PRESENCE OF MAGNETIC FIELDS GREATER THAN CYCLOTRON. Arkhipenko, V. I.; Budnikov, V. N.; Obukhov, A. A. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). Translated from report NP-19073. 6p. Dep. NTIS.

A study was made of the discharge formed by microwave power in the presence of magnetic fields larger than the cyclotron field at a distance from the absorption boundary: $H > H_0 = mc\omega/e$, $\omega < \omega_{He} = eH/mc$. The experimental conditions are as follows: an argon plasma at a pressure of 10^{-1} to 10^{-3} mm Hg was created in a quartz container 70 cm long and 2.5 cm in diameter placed inside a 10-cm waveguide as a result of absorption of power from a stationary 10-cm source. In the absorption region, lines were detected on transitions through which a discontinuous change in the discharge parameters took place. The position of these lines is described by the formulas of a one-dimensional wave transformation model in the plasma analogous to those that describe the transformation boundary position. (auth)

6693 SPECTROSCOPIC ANALYSIS OF PLASMAS PRODUCED BY FISSION FRAGMENTS. Walters, R. A. (Martin Marietta Corp., Orlando, Fla.); Schneider, R. T. Trans. Amer. Nucl. Soc.; 15: No. 2, 634(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6694 MONTE CARLO SIMULATION OF RADIATION-INDUCED PLASMAS. Wang, B. S.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 15: No. 2, 795-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Stability

Refer also to abstracts 6638 and 6745.

6695 (AD-741912) CURRENT ALGEBRA OF GLOBAL MHD STABILITY. Wells, D. R. (Miami Univ., Coral Gables, Fla. Dept. of Physics). 1972. 53p. (MIAPH-PP-70-13; AFOSR-TR-72-1039). NTIS.

A theory of nonlinear global magnetohydrodynamic stability is described. The formalism is an entirely new approach to the problem. The concepts of space–time and generalized gauge symmetries of the flow fields are invoked to find constants of the motion. The constants correspond to charge operators in a theory of the current algebra of the fields. The charges, in turn, are defined by integrals that are determined by the symmetries of the fields. The strengths of the individual components of the currents determine the amount of symmetry breaking in each physical situation. The constants of the motion corresponding to the charge operator are used in conjunction with the principle of least constraint to generate the Euler–Lagrange equations corresponding to stable plasma motion. (auth) (GRA)

6696 (AEC-tr-7384) THEORY OF HYDRODYNAMIC STABILITY OF A PLASMA IN THE FIELD OF AN ALFVEN WAVE OF FINITE AMPLITUDE. Elfimov, A. G.; Nekrasov, F. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Sukhumi. Fiziko-Tekhnicheskii Institut). Translated from report NP-19260. 20p. Dep. NTIS.

The stability of a plasma located in the field of a self-consistent Alfvén wave was studied. The decay instabilities were investigated for a plasma with $\beta \gg 1$. The increments and widths of the instability zones are found. The problem of determining the critical

wave amplitude is discussed. The entire solution was found for two types of alfven waves: standing and traveling. This permitted investigation of the difference between the decay instabilities and the parametric instabilities in a uniform high-frequency field. In the second approximation, by the parameter h_0/H_0 (h_0 is the alfven wave amplitude, H_0 is the permanent magnetic field intensity), the instability associated with dispersion of the Alfvén waves was found. The excitation conditions of this instability are less rigid than the excitation conditions of the decay instabilities. Problems connected with buildup of the instabilities of the investigated type in systems bounded along a magnetic field are discussed. (auth)

6697 PARAMETRIC INSTABILITY OF A SPATIALLY MODULATED PLASMA. Repalov, N. S.; Tyrnov, V. F. (Physical-Technical Inst., Kharkov). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 719-23(Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 905-11(May 1972).

An instability caused by modulation of a plasma by a spatially periodic external electric field is studied. A dispersion equation is derived for an arbitrary set of coupled modes; the resonance conditions are found and the corresponding growth rates are calculated. The frequencies amplified by a beam are bound from below by plasma trapped by the modulating field and from above by the thermal motion of the beam particles. (auth)

6698 STABILIZATION OF THE KITE INSTABILITY IN A TWO-COMPONENT RELATIVISTIC RING BY AN AZIMUTHAL MAGNETIC FIELD. Bonch-Ostolovskii, A. G.; Reshetnikova, K. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 782-4(Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 987-90(May 1972).

A "kite" instability in the presence of an azimuthal magnetic field is considered on the basis of a two-beam hydrodynamic model. A strong magnetic field can cause a marked change of the region of stability. In particular, the instability can be stabilized for significant beam densities. (auth)

6699 ION-CYCLOTRON INSTABILITY OF A PLASMA PRODUCED BY A FAST-ION BEAM. Pereverzev, G. V. (Moscow State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 863-5(Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 1085-8(May 1972).

From the solution of the Vlasov equation, an equation is obtained for the oscillations of a plasma with azimuthal particle fluxes. The ion-cyclotron instability in a plasma in the form of a hollow cylinder formed by azimuthal Larmor rotation of fast ions in a magnetic field directed along the axis of the plasma cylinder is investigated. It is shown that this instability differs from the corresponding instability in a uniform plasma. Hydrodynamic, kinetic, and dissipative cyclotron instabilities are investigated and the growth rates, thresholds, and coupling conditions are determined. The results are in agreement with experimental data obtained on the AS device. (auth)

6700 ELECTRON TEMPERATURE-GRADIENT INSTABILITY AND ANOMALOUS SKIN EFFECT IN TOKAMAKS. Liu, C. S. (Inst. for Advanced Study, Princeton, N. J.); Rosenbluth, M. N.; Horton, C. W. Jr. Contracts AT(11-1)-3237; AT(40-1)-3458. Phys. Rev. Lett.; 29: No. 22, 1489-92(27 Nov 1972).

The drift-wave instability due to an electron temperature gradient opposite to the density gradient is analyzed as a possible explanation for the observed anomalous skin effect in tokamaks. (auth)

6701 LONG-WAVELENGTH ION-ACOUSTIC WAVES. Bateman, Glenn (New York Univ., N. Y.). Contract AT(30-1)-1480. Phys. Rev. Lett.; 29: No. 22, 1499-1501(27 Nov 1972).

The time dependence of current and temperature in a spatially uniform plasma, and the nature of the ion heat sink as a function of density and ion temperature, have a profound effect on the stability of ion-acoustic waves with wavelengths much longer than the electron mean free path. (auth)

6702 PARAMETRIC INSTABILITY AND ANOMALOUS HEATING DUE TO ELECTROMAGNETIC WAVES IN PLASMA. Porkolab, M.; Arunasalam, V.; Ellis, R. A. Jr. (Princeton Univ., N. J.). Phys. Rev. Lett.; 29: No. 21, 1438-41(20 Nov 1972).

Experimental results are presented which verify the fundamental aspects of the parametric instability of whistler waves. The accompanying fast heating of plasma is interpreted to be due to anomalous absorption. (auth)

6703 THEORY OF TRAPPED-PARTICLE INSTABILITY. II. STABILITY OF A SMALL-AMPLITUDE B-G-K WAVE. Mima, K. (Kyoto Univ.); Nishikawa, K. J. Phys. Soc. Jap.; 33: No. 6, 1669-77(Dec 1972).

In a preceding report, (J. Phys. Soc. Japan, 30: 1722(1971)) a general theory was developed to investigate the stability of a collisionless, one-dimensional plasma which sustains a large-amplitude, monochromatic electron plasma wave. In this paper, this theory is used to investigate further details of the instability by assuming a specific form of the unperturbed distribution, such that it is consistent with the small-amplitude limit of a Bernstein-Greene-Kruskal distribution. The properties of the dispersion relation are characterized by three parameters, the wavenumber of the carrier, its amplitude, and the excess trapped-electron density ΔN_t (compared with the value expected from the linear theory). In the weak-coupling limit, the stable and unstable regions are shown in the plane spanned by ΔN_t and bounce frequency. A numerical calculation for a moderately strong-coupling case shows that even in this case growing waves are separated into several distinct wave-number regions. (auth)

6704 STABILIZATION OF HYDROMAGNETIC INSTABILITIES BY MAGNETIZATION CURRENTS. Lehmann, H.-R.; Treumann, R. (Heinrich-Hertz-Institut fuer Schwingungsforschung, Berlin). Nature (London) Phys. Sci.; 239: No. 96, 146-7 (30 Oct 1972).

The importance of hydromagnetic instabilities in collisionless anisotropic plasmas has long been established, especially for cosmic plasmas and solar-wind conditions. These instabilities, in their simplest version, arise from the presence of anisotropic plasma pressure or, in the context of kinetic theory, from the anisotropy of the particle equilibrium velocity distribution. Previous work in this field, however, has been concerned only with homogeneous plasmas in which magnetization currents are absent. The present communication refers to nonhomogeneous conditions, where magnetization currents become important, and the influence of these currents on the development of linear hydromagnetic instabilities is considered. Two new conditions are found for the development of pure growing hydromagnetic instabilities. The magnetization current broadens the region of hydromagnetic stability, and hence it seems to act in a stabilizing fashion on the plasma. (UK)

6705 MECHANISM FOR ESTABLISHING STATIONARY PLASMA TURBULENCE. Akhiezer, I. A.; Angeleiko, V. V. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 9, 1431-7(Sep 1972). (In Russian).

It is shown that, besides the well-known mechanism for establishing stationary plasma turbulence (rise of a balance between pumping-in and pumping-out oscillations), another mechanism is possible. Namely, the change in the phase velocity of waves caused by nonlinear effects may result in violation of the growth condition for all the waves capable of propagating in plasma. The stationary level of turbulent magneto-acoustic oscillations in plasma penetrated by a beam of charged particles is determined. (auth)

6706 LOCAL HYDROMAGNETIC TOROIDAL EQUILIBRIA WITHOUT SYMMETRY. Hamada, Sh. (Nihon Univ., Tokyo). Nucl. Fusion; 12: No. 5, 523-44(Sep 1972).

As a step in solving the so-called resonance problems, a method of formal expansion in the neighborhood of an arbitrarily shaped toroidal magnetic surface is developed. Sufficient conditions for the existence of all coefficients of the power-series expansion of equilibrium quantities with respect to the volume contained between each magnetic surface and the prescribed one are presented for arbitrarily prescribed distributions of pressure and rotational transform ratio and for the surface harmonic with an arbitrary weight on the initially prescribed magnetic surface. It is suggested that the conditions should usually also be necessary in the case of asymmetry. The conditions are written in terms of similar functions appearing in the well-known condition of local stability. A possibility that nonexistence of equilibrium without symmetry may occur in a certain case is suggested. Relations between the existence theorems previously proposed by several authors and our results are discussed to be consistent except for the foregoing case. Convergence of the formal solutions has, however, not yet been examined. (auth)

6707 HYDRODYNAMIC INSTABILITY OF A PLASMA BOUNDARY WITH A MAGNETIC FIELD TAKING ACCOUNT OF THE VISCOSITY. Imshennik, V. S. (Inst. of Applied Mathematics, Moscow). Dokl. Akad. Nauk SSSR; 204: No. 6, 1335-8 (21 Jun 1972). (In Russian).

Movement of a plasma boundary with a magnetic field is characteristic of rapid processes in a pinch-effect type of plasma. The effect of viscosity on the instability of a plasma boundary with a magnetic field was examined, preserving all of the original hypotheses from published work by Kruskal and Schwarzschild (1954) and Stiks (1965). The plasma was considered incompressible, homogeneous, and isotropically viscous. The starting point for the development was the magnetohydrodynamic equations for an infinite, conducting plasma. (K.S.W.)

6708 APPLICATION OF FOURIER ANALYSIS OF THE AZIMUTHAL FIELD DISTRIBUTION TO A STUDY OF EQUILIBRIA AND INSTABILITIES IN A TOROIDAL PINCH DISCHARGE. King, R. E.; Robinson, D. C.; Verhage, A. J. L. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Phys., D (London); 5: No. 11, 2015-25(Nov 1972).

The equilibrium displacement of a current-carrying plasma column in a torus was determined from measurements of the first-order Fourier component of the azimuthal field using coils with the number of turns per unit length varying sinusoidally. The displacement cannot be obtained directly if currents flow outside the plasma column, but an independent measurement of the displacement then yields information about the current distribution. Parameters associated with helical equilibria and instabilities such as growth, radius and wavelength are obtained from the Fourier components. (auth)

6709 TWO-DIMENSIONAL INVESTIGATION OF ABSOLUTE INSTABILITIES IN MIRROR PLASMAS. Jong, R. A.; Kammash, T. (Univ. of Michigan, Ann Arbor). Nucl. Fusion; 12: No. 5, 545-59(Sep 1972).

A two-dimensional criterion for distinguishing absolute instabilities with arbitrary propagation in an infinite magnetized plasma is developed and applied to mirror-confined plasmas. It is shown that this criterion follows directly from the one-dimensional criterion by careful consideration of the singularities in the inverse Fourier–Laplace transform integrals. A number of instabilities, generally referred to as loss-cone instabilities, are numerically investigated using the above criterion and the results compared to those available from one-dimensional calculations where growth is restricted to the direction parallel to the magnetic field. It is found that for the loss-cone instability the one-dimensional calculation gives good estimates of the transition density and real parallel wave number as a function of the electron temperature, but yields an overestimation of the maximum axial convective growth rate. When the effects of ion temperature anisotropy are examined it is shown that the two-dimensional calculation is required because of the great and sensitive dependence of the transition density on the value of the perpendicular wave number. Although the stabilizing effect of increased electron temperature on the loss cone, drift cone, and drift cyclotron instabilities is confirmed, it is found that this effect is smaller in the case of the drift-cyclotron mode. Moreover, the presence of a cool ion component in a hot loss-cone plasma is shown to have only a small stabilizing effect at the first ion cyclotron harmonic. The Dory–Guest–Harris instability associated with the ring distribution is shown to be absolute for flute-like modes, while for oblique propagation it is shown that an absolute instability cannot exist. For all modes, the one-dimensional calculation gives somewhat pessimistic results regarding the dimensions of a stable plasma. By allowing for spatial decay normal to the magnetic field the two-dimensional investigation shows that the plasma need not be as "stubby" to be stable against the loss-cone modes. (auth)

6710 NUMERICAL ANALYSIS OF MAGNETOHYDRODYNAMIC INSTABILITIES BY THE FINITE ELEMENT METHOD. Takeda, Tatsuoki; Shimomura, Yasuo; Ohta, Mitsuru; Yoshikawa, Masaji (Japan Atomic Energy Research Inst., Tokai). Phys. Fluids; 15: No. 12, 2193-2201(Dec 1972).

A finite-element method was applied to the analysis of magnetohydrodynamic instabilities in a cylindrical current-carrying plasma embedded in a strong longitudinal magnetic field. To examine the applicability of the finite-element method to the stability analysis, the growth rate of instabilities was calculated numerically using an electronic computer. It was shown that the numerical results, for which corresponding analytical results are available, are in good agreement with them. Several examples of the analysis of low-m mode instabilities with various current distributions are demonstrated. It is concluded that the finite-element method is a powerful tool for the study of magnetohydrodynamic instabilities in the cylindrical plasma as well as, possibly, plasmas with more complex geometries. (auth)

6711 INHERENT ELECTROSTATIC INSTABILITY IN A LOW-DENSITY SINGLE-ENDED Q MACHINE. Estabrook, K.; Doucet, H. J.; Rouille, C. (Laboratoire de Physique des Milieux Ionises, Paris). Phys. Fluids; 15: No. 12, 2260-2(Dec 1972).

An inherent electrostatic instability in a low-density single-ended Q machine is investigated theoretically and experimentally. Using the Penrose and Jackson analysis, the plasma is shown to be unstable with respect to ion-acoustic waves for all negative potentials of the cold plate except for a narrow band of values slightly more negative than the plasma potential. The prediction is experimentally confirmed. (auth)

6712 KELVIN–HELMHOLTZ INSTABILITY IN A HIGH-β COLLISIONLESS PLASMA. Dobrowolny, Marino (European Space Research Inst., Frascati, Italy). Phys. Fluids; 15: No. 12, 2263-70(Dec 1972).

The stability of an inhomogeneous plasma, of arbitrary β, flowing along a straight magnetic field is studied. Both the velocity flow and the plasma density are spatially varying in a direction perpendicular to the field. For drift-type waves, very elongated along the magnetic field direction, an Alfvén wave branch and a magnetosonic branch turn out to be decoupled. It is found that both branches may be driven unstable by the velocity shear. Stability conditions are worked out, quantitatively discussed, and compared in terms of β and of the magnitude of the shear. (auth)

6713 SHEAR STABILIZATION OF THE DRIFT-CYCLOTRON INSTABILITY. Liu, C. S.; Bhadra, D. K. (Gulf General Atomic Co., San Diego, CA). Phys. Fluids; 15: No. 12, 2288-90(Dec 1972).

Drift-cyclotron instability is shown to be stabilized by the shear of the magnetic field for $L_n/L_s > (m/M)^{1/2}$, where L_n is the density scale length and L_s is the shear length. (auth)

6714 ALFVEN CYCLOTRON RESONANCE INSTABILITY IN MIRROR MACHINES. Cordey, J. G.; Hastie, R. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Fluids; 15: No. 12, 2291-4(Dec 1972).

The stability of the collisional distribution of a mirror machine against the Alfvén cyclotron resonance mode is examined. This instability which is shown to have a growth rate which scales as $\gamma \sim \omega_{ci} \exp(-R^{1/4}/\beta^{1/4})$ for $R\beta < 1$ may be dangerous for low-beta mirror plasmas as well as high-beta plasmas. (auth)

6715 ANOMALOUS RESISTANCE DUE TO CROSS-FIELD ELECTRON–ION STREAMING INSTABILITIES. Lampe, Martin; Manheimer, W. M.; McBride, J. B.; Orens, J. H. (Naval Research Lab., Washington, DC). Phys. Fluids; 15: No. 12, 2356-62(Dec 1972).

New computer simulations show that the nonlinear stage of the beam cyclotron instability is stabilized if $T_i/T_e \gtrsim v_d/v_e$, similar to ion sound, as has been predicted theoretically. In this case, the instability makes no significant contribution to anomalous resistance, for the conditions of typical laboratory resistive shocks. In the opposite case, a theoretical study of the later development shows that after the onset of ion trapping, both wave energy and electron temperature grow linearly with time, and the anomalous electron–ion collision frequency becomes constant at ~0.02 times the electron plasma frequency. These conclusions are supported by simulation studies. (auth)

6716 QUASILINEAR THEORY OF THE MIRROR FLUTE INSTABILITY. Simon, Albert; Weng, C. I. (Univ. of Rochester, NY). Phys. Fluids; 15: No. 12, 2341-50(Dec 1972).

The nonlinear small-amplitude behavior of a collisionless plasma is studied at the mirror flute instability threshold. A treatment assuming a "constant gravity" model of the mirror field predicts saturation of the m = 1 mode amplitude in disagreement with experiment. A model using nonconstant gravity yields the previous threshold mode and an upper damped mode. Nonlinear analysis shows the upper mode to be nonlinearly unstable. If the lower mode reaches sufficient amplitude, it triggers the upper and is itself shut off. The resulting behavior is in general agreement with experiments. (auth)

6717 NONLINEAR EVOLUTION OF WHISTLER INSTABILITIES. Ossakow, S. L.; Ott, Edward; Haber, Irving (Naval Research Lab., Washington, DC). Phys. Fluids; 15: No. 12, 2314-26(Dec 1972).

Theoretical and computer simulation studies of whistler instabilities in anisotropic collisionless plasmas are presented. Initial bi-Maxwellian, Maxwellian with loss cone, and hot Maxwellian superimposed on a more dense cold isotropic background electron distributions were used. Many of the observed features are common to all cases. Initially, the total wave magnetic energy grows; the average growth rate is in good agreement with linear theory; and the electron distribution isotropizes rapidly with a concomitant switching off of high k number, initially unstable waves. Then, the total wave magnetic energy saturates and at this time there is a residual kinetic energy anisotropy. This anisotropy persists after saturation, although there is a further tendency toward isotropy, together with a further switching off of the higher mode numbers for the remainder of the simulation. Throughout the simulation experiments the perpendicular and parallel energy constants are conserved to good accuracy. (auth)

6718 STABILIZATION OF THE MODIFIED NEGATIVE MASS INSTABILITY. Callen, J. D. (Massachusetts Inst. of Tech., Cambridge); Horton, C. W. Jr. Phys. Fluids; 15: No. 12, 2306-13(Dec 1972).

Previous studies of the resonant, modified negative mass instabilities in finite mirror-confined plasmas with highly anisotropic velocity distributions have shown that, at least when the bounce harmonic structure is ignored, a small thermal spread in the pitch-angle or energy distribution does not stabilize the modes. Bounce harmonic effects with no thermal spread have been shown to introduce new unstable modes. Combining the bounce and thermal spreading effects. It is found that the negative mass modes are all stabilized if $\eta_\Delta \equiv \Delta^2\Omega_0/\omega_b > 0.77$, where $\Delta \sim (T_\parallel/T_\perp)^{1/2}$ is the thermal spread (half-width at half-maximum) in the pitch-angle distribution, Ω_0 is the minimum gyrofrequency, and ω_b is the average bounce frequency. (auth)

6719 ANOMALOUS RESISTANCE DUE TO CROSS-FIELD ELECTRON-ION STREAMING INSTABILITIES. Forslund, D. W.; Morse, R. L.; Nielson, C. W. (Los Alamos Scientific Lab., NM). Phys. Fluids; 15: No. 12, 2363-6(Dec 1972).

There are important features of the nonlinear development of the electron cyclotron drift instability that have not been considered by M. Lampe, W. M. Manheimer, J. B. McBride, and J. H. Orens [Phys. Fluids, 15: 2356(1972)]. In contrast with Lampe et al. it is maintained that in the nonlinear growth phase in a weak magnetic field, many properties of the waves are unlike those of the magnetic field free ion-acoustic instability and that coherent electron trapping explains the dependence of the nonlinear properties on magnetic field strength. On the other hand, it now appears that Lampe et al. agree that this instability leads to a large effective collision frequency associated with sustained electron heating and a high level of turbulence. Details of the areas of agreement and disagreement are given along with a more detailed discussion of the nonlinear electron behavior. (auth)

6720 ALTERNATING CURRENT INSTABILITY PRODUCED BY THE TWO-STREAM INSTABILITY. Kainer, S.; Dawson, J.; Coffey, T. (Naval Research Lab., Washington, DC). Phys. Fluids; 15: No. 12, 2419-22(Dec 1972).

Theory and numerical experiments show that large-amplitude plasma oscillations are unstable when the mobility of the ions is taken into account. This instability can lead to an anomalously rapid damping of the plasma oscillations. It is expected that large amplitude plasma oscillations produced by the electron two-stream instability would be subject to this instability and the associated damping. Numerical experiments were performed which indicate that this is so and that there is good correspondence to theory. (auth)

Thermonuclear Processes

Refer also to abstract 5707.

6721 (AEC-tr-7389) DEVELOPMENT OF FAST ATOM INJECTORS FOR THERMONUCLEAR INSTALLATIONS IN THE U.S. Semashko, N. N. Translated from At. Energ. (USSR); 33: No. 1, 599-600(1972). 5p. Dep. NTIS.

Fast-particle injectors designed in the U. S. for confinement of plasma in open traps or for heating plasma in closed systems for the purpose of producing shaped flows at tens of amperes and particle energies in the range of units and tens of kiloelectron volts are examined. (auth)

6722 (EUR-4873) SURVEY OF FUSION REACTOR TECHNOLOGY. Definition of Problems. (Euratom Fusion Reactor Technology Advisory Group). Aug 1972. 300p. Dep. NTIS (U. S. Sales Only).

The survey articles reported represent the state of fusion reactor technology at the end of the year 1971, with emphasis only on toroidal reactors with magnetically confined plasma. Topics covered are: systems studies, blanket problems, radiation damage in components of a fusion reactor, plasma/vacuum wall interface and fuel problems, and electrochemical aspects and components. (auth)

6723 MOTION OF A CYLINDRICAL CONDUCTING SHELL UNDER MAGNETODYNAMIC COMPRESSION. Timonin, A. M.; Churaev, V. A. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 788-92(Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 995-1000(May 1972).

The magnetodynamic compression of a long cylindrical conducting shell of arbitrary wall thickness is solved exactly. The magnetic flux within the volume of the shell is assumed to be constant and energy losses are neglected. The compression field is produced by an inductive energy-storage circuit. The time and speed of compression are obtained as functions of the geometrical parameters and the ratio of the initial energy of the compression field to the energy of the field within the shell at the onset of compression. (auth)

6724 POTENTIAL DROPS NEAR THE ELECTRODES IN A PULSED PLASMA ACCELERATOR. Gubarev, V. Ya.; Kozlov, N. P.; Protasov, Yu. S.; Khvesyuk, V. I. (Moscow Higher Technical Coll.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 818-19(Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 1033-4(May 1972).

Results are presented on the potential drop near the electrodes in a pulsed, dielectric-erosion plasma accelerator. This drop is related to the discharge current and the accelerator geometry. It is found that the electrode loss accounts for 10 to 15% of the energy supplied to the discharge. (auth)

6725 FORMATION AND DESTRUCTION OF MAGNETIC ISLANDS IN TOROIDAL SYSTEMS. Hamzeh, F. M. (Univ. of California, Berkeley). Phys. Rev. Lett.; 29: No. 22, 1492-5 (27 Nov 1972).

A theoretical study is presented of formation and destruction of magnetic surfaces in toroidal systems. As applied to levitrons the theory agrees with the numerical results. (auth)

6726 WORLD ENERGY RESERVES AND SOME SPECULATIONS ON THE FUTURE OF NUCLEAR FUSION ENERGY. Tuck, J. L. (Los Alamos Scientific Lab., N. Mex.). pp 192-231 of Cosmology, Fusion, and Other Matters. /Reines, F. (ed.). Boulder, Colo.; Colorado Associated University Press (1972).

A brief discussion of fossil, fission, and fusion fuel reserves is presented. Some of the basic fusion experimental approaches are described along with their problems and possibilities. (M.O.W.)

6727 FUSION REACTOR STUDIES IN THE UNITED KINGDOM. Hancox, R. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Trans. Amer. Nucl. Soc.; 15: No. 2, 626(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6728 FUSION POWER: PAST, PRESENT, AND FUTURE. Hirsch, R. L. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 626-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6729 FUSION REACTOR SYSTEMS. Ribe, F. L. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 627-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6730 MAJOR TECHNOLOGICAL PROBLEMS FOR FUSION REACTOR POWER STATIONS. Kulcinski, G. L. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 15: No. 2, 628(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6731 ENVIRONMENTAL ASPECTS OF FUSION POWER PLANTS. Fraas, A. P. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 628-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6732 NEUTRONIC ANALYSIS OF A CTR BLANKET BENCHMARK BY DISCRETE ORDINATES. Dudziak, D. J. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 630-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6733 TRITIUM-PRODUCTION MEASUREMENT WITH APPLICATION TO FUSION REACTOR BLANKET DESIGN. Muir, D. W. (Los Alamos Scientific Lab., N. Mex.); Wyman, M. E. Trans. Amer. Nucl. Soc.; 15: No. 2, 631(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6734 DIRECT PUMPING OF LASERS BY FUSION REACTORS. Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 15: No. 2, 633-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6735 ANISOTROPY OF THE NEUTRON FLUENCE FROM A PLASMA FOCUS. Lee, J. H. (Vanderbilt Univ., Nashville); Shomo, L. P.; Kim, K. H. Phys. Fluids; 15: No. 12, 2433-8(Dec 1972).

The fluence of neutrons from a plasma focus was measured by gamma spectrometry of an activated silver target. This method results in a significant increase in accuracy over the beta-counting method. Multiple detectors were used in order to measure the anisotropy of the fluence of neutrons. The fluence was found to be concentrated in a cone with a half-angle of 30° about the axis, and to drop off rapidly outside of this cone; the anisotropy was found

to depend upon the total yield of neutrons. This dependence was strongest on the axis. Neither the axial concentration of the fluence of neutrons nor its dependence on the total yield of neutrons is explained by any of the currently proposed models. Some other explanations, including the possibility of an axially distributed source, are considered. (auth)

6736 E-LAYER COMPRESSION BY A TOROIDAL MAGNETIC FIELD. Rensink, M. E. (Univ. of California, Livermore). Phys. Fluids; 15: No. 12, 2391-5(Dec 1972).

The effect of an adiabatically increasing toroidal magnetic field (B_θ) on the E layer in astron is analyzed. Adiabatic invariants are calculated for particles in combined poloidal and toroidal magnetic fields. The current density increases with B_θ owing to reduction in the minor dimensions of the ring. To obtain significant compression the toroidal field at the ring must be larger than the poloidal guide field. Effects of the self-field of the ring and image currents in nearby conducting walls are included. (auth)

6737 THEORETICAL ASPECTS OF ASTRON BUILDUP BY MULTIPLE PULSES. Berk, H. L.; Pearlstein, L. D. (Univ. of California, Livermore). Phys. Fluids; 15: No. 12, 2396-2404 (Dec 1972).

The time-asymptotic response to an incoming current source in the presence of a partially built-up E layer in the astron geometry is examined. A one-dimensional Vlasov model which considers only motion in the axial direction (perpendicular to the current direction and tank radius) is studied. It is shown that (1) A back current is induced in the E layer. (2) A new dissipation mechanism (Landau damping) occurs in the E layer as well as in the resistors. (3) The dissipation in the layer causes particle scattering that leads to axial expansion which competes with contraction due to the addition of current. The net effect for a neutralized layer can lead to a saturation in E layer strength, a behavior encountered in numerical experiment. For the unneutralized layer, however, this situation is not nearly as severe and there appears to be a parameter range where stacking should occur. (auth)

6738 MAGNETIC CONFINEMENT CONFIGURATION FOR PLASMAS CARRYING HIGH CURRENTS. Coppi, B.; Dagazian, R.; Gajewski, R. (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids; 15: No. 12, 2405-18(Dec 1972).

A magnetic plasma confinement configuration aimed at sustaining high-current densities is proposed. It involves a small triangular and elliptic deformation imposed over a circular cross section of the plasma column by a surrounding conducting shell at close distance. The stability against kink modes is analyzed and shown to be the same as that of an equivalent plasma column with equal area, but circular cross section. An assessment of the over-all stability of this configuration points to a significant improvement, in terms of the Ohmic heating resulting from the induced current, over the known configurations with circular cross section. (auth)

Wave Phenomena

6739 (AD-741754) ARTIFICIAL TRANSMISSION LINE FOR STUDIES OF TRANSIENT PROPAGATION IN PLASMA MEDIA. Antonucci, J. D. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 24 Jan 1972. 62p. (AFCRL-PSRP-475; AFCRL-72-55). NTIS.

A lumped circuit transmission line which simulates a plasma was developed. Analogies were established by comparing the equations for the propagation of voltage in the line and the propagation of electromagnetic waves in dispersive media. The network simulated the one-dimensional isotropic case in which the plasma was linear, homogeneous, and lossless. Both bounded and unbounded plasmas were considered. The transient reflected and transmitted response was measured for the step carrier sine wave, the step function, and the impulse inputs. Phenomena such as ringing and time delay were observed, both of which are related to the plasma frequency. Methods of obtaining plasma slab thicknesses were also investigated. (auth) (GRA)

6740 (AEC-tr-7368) STUDY OF THE AMPLITUDE OF AN ELECTROMAGNETIC WAVE REFLECTED FROM THE BOUNDARY OF AN ANISOTROPIC PLASMA. Adamov, I. Yu.; Berezhnyi, V. L.; Dushin, L. A.; Lebedev, P. M.; Kononenko, V. I. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). Translated from report KHFTI-71-25. 11p. Dep. NTIS.

The graphical amplitude characteristics of an electromagnetic wave reflected from the boundary of an anisotropic plasma oriented perpendicular to the direction of the magnetic field were obtained as functions of the plasma density, the collision frequency, the magnetic field, and the frequency of signal probing the plasma by computer calculations. These functions can be used in practice to determine the density of anisotropic plasma when measuring the amplitude of a reflected electromagnetic wave. (auth)

6741 (AEC-tr-7374) SELF-STRESS OF ELECTROMAGNETIC WAVES IN A DENSE COLLISIONLESS PLASMA. Batanov, G. M.; Silin, V. A. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). Translated from report NP-19164. 9p. Dep. NTIS.

A study was made of the conditions of the striction and thermal mechanisms of superhigh-frequency self-stress in a collisionless plasma. The penetration of a powerful 10 cm electromagnetic wave into a dense plasma is studied experimentally. The maximum electron concentration in the layer of collisionless plasma exceeds the critical concentration by five times. The penetration of the superhigh-frequency waves through the plasma layer at $E_0^*/8\pi \ll nT_e$ was recorded. By means of the Langmuir probe and microwave diagnostic measurements, the ion-sound vibrations were detected in the region close to plasma resonance. The observed effects are explained by the occurrence of a parametric instability of the plasma in the microwave field. (auth)

6742 (AEC-tr-7378) PENETRATION OF WAVES INTO A PLASMA AT FREQUENCIES CLOSE TO THE LOWER HYBRID FREQUENCY. Golant, V. E. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). Translated from report NP-19076. 20p. Dep. NTIS.

The penetration of electromagnetic waves into a magnetized plasma in the region of the lower hybrid "resonance," in which their transformation into slow strongly damping plasma waves takes place, is discussed. The conditions of penetration of the waves in uniform and nonuniform magnetic fields are analyzed, and the efficiency of the wave input to the plasma for these conditions is studied. (auth)

6743 (ITF-72-77-E) DESCRIPTION AND PROPERTIES OF AN R.F. PLASMA DESIGNED FOR THE STUDY OF PARAMETRIC INTERACTION OF A STRONG E.M. FIELD WITH PLASMA. Muazan, M. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 36p. Dep. NTIS (U. S. Sales Only).

The operating properties as well as some technical details are discussed for an rf resonant plasma (Tonks–Dattner resonances) in which high-intensity rf electric field is produced in this self-sustaining plasma; the electron rf oscillation amplitude is about 20 times larger than the electron Debye length. The experimental setup was designed to study parametric resonance instabilities: one can easily measure f_R/f_0 the ratio of the average electron plasma frequency to the rf external field frequency, while simultaneously observing very pure, noiseless, unstable spectral emissions resulting from the high intensity rf field: noiseless operation comes from a very low electron density random fluctuations rate, $\sim 10^{-5}$. One can also determine the azimuthal configuration of the spectra that are emitted and it should even be possible to localize and study the parametric interaction region in the plasma. (auth)

6744 INCOHERENT EXCITATION OF PLASMA OSCILLATIONS BY AN ALMOST-MONOENERGETIC RELATIVISTIC BEAM. Pakhomov, V. I.; Sizonenko, V. L. (Physical-Technical Inst., Kharkov). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 866-7(Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 1088-90(May 1972).

The oscillations excited in an unbounded cold isotropic plasma by an almost-monoenergetic relativistic beam of electrons are studied. It is shown that plasma waves propagating perpendicularly to the beam velocity are excited by resonance particles. The growth rate of these oscillations is of the same order of magnitude as the growth rate for waves excited coherently by all the beam particles. (auth)

6745 SURFACE DRIFT WAVES IN A WEAKLY IONIZED PLASMA. Lovetskii, E. E. (Moscow Engineering Physics Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 5, 724-6 (Nov 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 5, 912-15(May 1972).

A model collision integral is used to study drift-dissipative waves in a weakly ionized plasma for the case in which the wavelength is large in comparison with the scale size of the plasma inhomogeneity. These modes are excited before the corresponding short-wave modes. Spectra of drift-dissipative waves and conditions for stabilization are obtained. (auth)

6746 WAVE PROPAGATION IN MULTICOMPONENT PLASMAS. Gupta, R. M. (Univ. of Rajasthan, Jaipur, India). Beitr. Plasmaphys.; 12: No. 3, 179-83(1972).

The well-known linearization technique is used to derive the dielectric tensor for a multicomponent plasma in the presence of a

static magnetic field. The equation of motion for various species of particles is considered with Maxwell's field equations, and the dispersion relation for different specific cases is obtained. (auth)

6747 NONLINEAR WAVE MODULATION IN COLD MAGNETIZED PLASMAS. Kako, Masashi (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 33: No. 6, 1678-87(Dec 1972).

Nonlinear modulation of waves in a cold plasma is investigated with a modification of a perturbation method developed by Taniuti and Yajima. In particular, it is shown that a modulated electron–cyclotron wave is influenced by a slow motion of the plasma and that there is a critical wave number for the onset of modulational instability. The critical wave number is found to be independent of the direction of propagation, i.e., $k_{c\,if} = \omega_{pe}/c\sqrt{3}$, where ω_{pe} and c are the plasma frequency and the light velocity, respectively. A lower hybrid wave, which propagates perpendicular to a uniform magnetic field, is shown to be stable against the wave modulation and, in the limit of small wave number, the modulated wave is an oscillatory solution of the Korteweg–de Vries equation obtained by Gardner and Morikawa. (auth)

6748 NONLINEAR DAMPING OF LONGITUDINAL ION OSCILLATIONS IN A COLLISIONLESS NONISOTHERMAL PLASMA. Vaclavik, J. (Univ., Fribourg, Switzerland). Phys. Lett.; 42A: No. 1, 103-4(6 Nov 1972).

The damping coefficient of ion oscillations is generalized to be valid for times comparable with the electron and ion trapping times. (auth)

6749 COLLISIONAL DAMPING OF TRANSVERSE WAVES IN A PLASMA. Abrol, P. S.; Varma, N. L. (Univ. of Rajasthan, Jaipur, India). Z. Phys.; 255: No. 4, 300-7(1972).

The effect of collisions on transverse waves in a homogeneous, field free plasma is investigated by means of Gross–Krook collision model. The dispersion relation is calculated by assuming the collision frequency to be small and $K\lambda_D \ll 1$. The damping rate ω_I is obtained as

$$\omega_I = \frac{\nu_{ei}}{2}\frac{\omega_p^2}{\omega_0^2}\left[1 + \frac{3K^2\lambda_D^2\omega_p^2}{\omega_0^2} - \frac{K^2\lambda_D^2\omega_p^4}{\omega_0^4}\right] + \frac{\nu_{ee}}{2}\frac{\omega_p^2}{\omega_0^2}\left(\frac{K^2\lambda_D^2\omega_p^2}{\omega_0^2}\right),$$

where $\omega_0^2 = c^2K^2 + \omega_p^2$, and ν_{ei} and ν_{ee} are electron–ion and electron–electron collision frequency, respectively. (auth)

6750 COMMENTS ON THE DAMPING OF FREE-STREAMING WAVES IN A PLASMA. Ikezi, H.; Kiwamoto, Y.; Lonngren, K. E. (Nagoya Univ., Japan). Phys. Lett.; 42A: No. 1, 29-30(6 Nov 1972).

An experiment is described in which free-streaming particles are launched by a grid. The damping of the signal satisfies the Hirshfield–Jacob criterion for wave propagation. (auth)

6751 WAVES IN INHOMOGENEOUS MAGNETOPLASMAS. Sivasubramanian, A.; Tang, T. W. (Univ. of Massachusetts, Amherst). Phys. Rev., A.; 6: No. 6, 2257-68(Dec 1972).

The linearized Vlasov equation for a hot inhomogeneous magnetoplasma is solved through the particle-orbit theory using the techniques of Fourier transforms. An analytical integral expression in $\vec{k}$ space is obtained for the current density for waves propagating across the static magnetic field. When inverse Fourier transformed, it gives rise to a differential expression which is accurate up to order $(r_c/\lambda)^2$, $(r_c^2/\lambda L)$, and $(r_c/L)^2$. The integral equation is solved numerically for the problems of Buchsbaum–Hasegawa resonances and the Bernstein modes propagating in an inhomogeneous magnetoplasma. (auth)

6752 LIFETIME OF ION WAVES IN UNSTABLE AND TURBULENT PLASMAS. Watanabe, S.; Tanaca, H. (Yokahama National Univ., Japan). Nucl. Fusion; 12: No. 5, 593-7(Sep 1972).

The lifetime of ion waves in unstable and turbulent plasmas is investigated experimentally. The lifetime, a measure of the autocorrelation time of ion waves, is studied by a Boxcar Integrator. In unstable states, lifetime strongly depends on the boundary condition of the plasma. In turbulent states, however, lifetime is almost constant and independent of the boundary conditions and the electron drift velocity, whereas the turbulence energy increases with the drift velocity. Such a constancy may be expected from the Wiener–Khintchine theorem in noise theory. Several types of interaction between ion waves like oscillatory energy exchange or mode locking are also examined. (auth)

6753 ZEMPLEN'S THEOREM FOR SHOCK WAVES IN PLASMAS ITH ANISOTROPIC PRESSURE. Kartalev, M. D. Dokl, Akad. Nauk SSSR; 205: No. 6, 1316-19(21 Aug 1972). (In Russian).

Shock waves in a collisionless plasma in a strong magnetic field were considered, assuming that the continuous movement of the plasma conformed to the system of quasi-linear system of equations of Chew, Goldberger, and Low (1956). Allowance was made for the laws of magnetohydrodynamics and for discontinuities in condensation and rarefaction (Zemplen's theorem). (K.S.W.)

6754 INVESTIGATION OF A THERMAL SELF-FOCUSING ELECTROMAGNETIC WAVE IN PLASMA. Eremin, B. G.; Litvak, A. G.; Poluyakhtov, B. K. (Scientific-Research Inst. of Radio Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 8, 1132-8(1972).

The results of experimental investigation of the thermal self-focusing uhf electromagnetic wave in an isotropic weakly ionized plasma are given. The observed peculiarities of this phenomenon are shown to be in good agreement with the existing theoretical assumptions. (auth)

6755 USE OF MULTIPLE SCATTERING THEORY TO DERIVE KINETIC EQUATIONS FOR WAVES IN A WEAKLY TURBULENT PLASMA. Apresyan, L. A.; Kravtsov, Yu. A. (Radiotechnical Inst., Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 8, 1260-2(1972). (In Russian).

A kinetic equation for a three-wave interaction was derived from the theory of multiple scattering of waves in random heterogeneities such as exist in a weakly turbulent plasma in which random fields are created by the nonlinearity of the plasma. The development employs Keller's equation (1968). (K.S.W.)

6756 RAY TRACING IN AN ANISOTROPIC ABSORBING MEDIUM. Suchy, K. (CNRS, Saint-Maur-des-Fosses, France). J. Plasma Phys.; 8: No. 1, 53-65(Aug 1972).

The Hamilton equations for group propagation in nonabsorbing media are generalized to include moderate absorption and to contain directional derivatives. Two iterative computational methods are presented for ray tracing with these generalized Hamilton equations. (auth)

6757 ERGODIC BEHAVIOUR OF NONLINEAR HYDROMAGNETIC WAVES IN A COLD COLLISIONLESS PLASMA. Inoue, Y.; Kimura, N. (Osaka Univ.). J. Plasma Phys.; 8: No. 1, 97-104(Aug 1972).

Nonlinear hydromagnetic waves propagating along a magnetic field in a cold collisionless plasma are investigated. A criterion for ergodicity of the waves is obtained using the usual method of analytical dynamics. (auth)

6758 STABILITY OF NONLINEAR COLD PLASMA WAVES. Infeld, E. (Inst. of Nuclear Research, Warsaw). J. Plasma Phys.; 8: No. 1, 105-10(Aug 1972).

The exact form of a nonlinear, stationary wave, travelling against a background of cold plasma, is investigated for stability. The result is that it is marginally stable, and therefore can exist in practice. Another problem, that of a nonlinear wave at rest against a background of two counter-streaming cold electron beams, is discussed. (auth)

6759 ELECTROSTATIC OSCILLATIONS IN PLASMAS WITH CUTOFF DISTRIBUTIONS. Canosa, Jose (IBM Scientific Center, Palo Alto, CA); Gazdag, Jeneo; Fromm, J. E.; Armstrong, B. H. Phys. Fluids; 15: No. 12, 2299-2305(Dec 1972).

When numerically solving the linear Vlasov equation with cutoff electron distributions, the well-known Landau-damped oscillation of the electric field was observed first but, after a short transition time, a constant-amplitude harmonic oscillation with a frequency distinctly higher than Landau's frequency was found. This coexistence of two distinct modes of oscillation—one damped and one undamped—has not been observed before. The behavior is explained quantitatively by comparison of the dispersion equation solution with the results obtained from the numerical solution of Vlasov's equation. (auth)

6760 EQUILIBRIUM AND STABILITY OF LARGE-AMPLITUDE MAGNETIC BERNSTEIN-GREENE-KRUSKAL WAVES. Berger, R. L.; Davidson, R. C. (Univ. of Maryland, College Park). Phys. Fluids; 15: No. 12, 2327-40(Dec 1972).

The stability of transverse magnetic Bernstein–Green–Kruskal waves to small-amplitude perturbations is analyzed within the framework of the Vlasov–Maxwell equations. The Vlasov–Maxwell equations are linearized about an equilibrium state which supports (selfconsistently) a spatially-periodic finite-amplitude transverse electromagnetic wave. An external magnetic field, $B_0 = B_0\hat{e}_z$, is included in the analysis, and spatial variations in equilibrium and perturbed quantities are taken to be in the z direction. A matrix dispersion relation is obtained that relates the (complex) oscillation frequency ω and wavenumber k of the perturbation; stability criteria are obtained for monochromatic circularly polarized equilibrium wave. As an example, a trapped electron distribution is considered which is isotropic and monoenergetic in the plane perpendicular to the propagation direction of the equilibrium wave, and cold parallel to the propagation direction. The ions

are assumed to form a cold neutralizing background. The system is found to be stable to transverse electromagnetic perturbations provided the equilibrium wave amplitude exceeds a certain threshold. The condition for stability is $\bar{\omega}_{Be} \gtrsim \gamma_k$ where $\bar{\omega}_{Be}$ is the magnetic bounce frequency for trapped electrons, and γ_k is the linear growth rate in the absence of the equilibrium wave. The results of the stability analysis are consistent with recent computer simulation experiments; for a broad class of transverse electromagnetic instabilities in anisotropic plasmas, these experiments (carried out both for $B_0 = 0$ and $B_0 \neq 0$) show that the linearly unstable field amplitudes saturate once $\bar{\omega}_{Be}$ has increased to a value comparable to γ_k. (auth)

6761 NONLINEAR FREQUENCY SHIFT OF A PLASMA MODE. Lee, A.; Pocobelli, G. (Univ. of Saskatchewan, Saskatoon). Phys. Fluids; 15: No. 12, 2351-5(Dec 1972).

The nonlinear frequency shift of an electron plasma mode is calculated without restriction to part of the electrons. A time-dependent dispersion equation solved numerically in the time-asymptotic limit yields, for phase/thermal velocity ratios $\gtrsim 4$, frequency shifts significantly larger than previously calculated. The relative contribution of trapped and untrapped electrons to the frequency shift varies widely with the wave amplitude and the phase/thermal velocity ratio. (auth)

6762 DAMPING OF ELECTRON PLASMA OSCILLATIONS IN A UNIFORM ELECTRIC FIELD. Bateman, Glenn (Princeton Univ., NJ). Phys. Fluids; 15: No. 12, 2295-8(Dec 1972).

The damping of electron plasma oscillations with large phase velocities is computed as the combination of Landau damping, collisional damping, a growth rate or damping explicitly due to a uniformly applied, steady electric field, and a complementary effect due to the time evolution of the background distribution function. A linear form of the moment equations is used to derive expressions for the field and time-dependent effects. The derivation does not depend upon the specific nature of the resistivity or other dissipative effects. An illustrative example is given for the competition between these effects when a small electric field and classical Ohmic heating are present. (auth)

6763 PROPAGATION OF AN ION RAREFACTION WAVE FROM A GROWING SHEATH. Andrews, J. G.; Shrapnel, A. J. (Marchwood Engineering Labs., Eng.). Phys. Fluids; 15: No. 12, 2271-4(Dec 1972).

The structure of an ion rarefaction wave propagating from a sheath growing into a nonuniform plasma column is determined using the method of characteristics. Ionization and collisions both tend to damp out the wave. The interaction between two identical ion rarefaction waves from opposite sides of a plasma column produces a secondary ion rarefaction wave which spreads outward from the center of the column. The density profile in the column relaxes toward a new equilibrium profile, corresponding to that for the new (i.e., contracted) column width. (auth)

6764 MODE-COUPLING AND WAVE–PARTICLE INTERACTIONS FOR UNSTABLE ION-ACOUSTIC WAVES. Martin, Pablo; Fried, B. D. (Univ. of California, Los Angeles). Phys. Fluids; 15: No. 12, 2275-84(Dec 1972).

A theory for the spatial development of linearly unstable, coupled waves is presented in which both quasilinear and mode-coupling effects are treated in a self-consistent manner. Steady-state excitation of two waves (with frequencies ω_1, ω_2) is assumed at the boundary $x = 0$, the plasma being homogeneous in the y and z directions. Coupled equations are derived for the x dependence of the amplitudes of the primary waves (ω_1, ω_2) and the secondary waves, $n\omega_1 + m\omega_2$ (n and m being integers), correct through terms of second order in the wave amplitude, $e\phi/T_e$, but without the usual approximation of small growth rates. This general formalism is then applied to the case of coupled ion-acoustic waves driven unstable by an ion beam streaming in the direction of the x axis. If the modifications of the ion beam by the waves ("quasilinear" effects) are ignored, "explosive" instabilities (singularities in all of the amplitudes at finite x) are found even when all of the waves have positive energy. If these wave–particle interactions are included, the solutions are no longer singular, and all of the amplitudes have finite maxima, at locations in reasonable agreement with experimental results of Taylor and Ikezi. (auth)

6765 ION-ACOUSTIC RADIATION GENERATED BY A PSEUDOWAVE: EXPERIMENT, THEORY, AND SIMULATION. Estabrook, Kent; Alexeff, Igor (Oak Ridge National Lab., TN). Phys. Fluids; 15: No. 12, 2285-7(Dec 1972).

A pseudowave packet propagating a high velocity through a plasma is observed to generate a "wake" of ion-acoustic waves radiating outward. When the pseudowaves are cut into laminations, a short sine wave train of ion-acoustic waves is observed to propagate perpendicular to the pseudowave paths. The method may be an excellent method of exciting pure ion-acoustic waves without the nonlinear sheath effects (streaming) inherent in the direct use of exciting electrodes. A theory and simulation of the ballistic-wave coupling which predict the observed waveform is discussed. (auth)

6766 LOW-FREQUENCY BEAM–PLASMA INTERACTIONS IN A FINITE-SIZED PLASMA. Bhatnagar, V. P.; Getty, W. D. (Univ. of Michigan, Ann Arbor). Phys. Fluids; 15: No. 12, 2222-30(Dec 1972).

Results are presented for an experimental and theoretical investigation of low-frequency waves in a beam-generated plasma. Waves are excited at frequencies immediately above the ion-plasma frequency by sinusoidally modulating the electron beam current. The study is aimed at obtaining ion heating at the lower-hybrid resonant frequency. An electron beam of 400 to 1000 V energy and a few milliamperes of current is used to generate plasmas with densities in the range of 10^9 cm^{-3} in a magnetic field of a few hundred gauss. Hydrogen, argon, deuterium, and neon gases are used. The rf electric field is probed as a function of r, z, and frequency, and energetic ions are detected by a gridded probe. Two or three resonances are found in the probe response above ω_{pi}, and are shown to be multiple half-wavelength resonances of standing plasma waveguide axisymmetric modes. A normal-mode analysis is used to calculate the probe responses and is found to correctly predict the effects of varying beam voltage, plasma density, ion mass, and dc axial magnetic field. The excited wave may be viewed as an electrostatic wave propagating at an angle very close to 90° from the magnetic field. (auth)

6767 SELF-CONSISTENT FINITE AMPLITUDE WAVE DAMPING. Oei, I. H.; Swanson, D. G. (Univ. of Texas, Austin). Phys. Fluids; 15: No. 12, 2218-21(Dec 1972).

An approximate self-consistent damping rate for a finite-amplitude wave is obtained. In the limit of $\gamma_L \tau_0 \gg 1$ and $\gamma_L \tau_0 \ll 1$, where γ_L is the linear Landau damping coefficient and τ_0 is the bounce period of the particles in the wave potential well, the linear Landau damping rate and O'Neil damping coefficient, respectively, are recovered from the generalized result, which is in the form of an integral equation. By the technique of numerical iteration, the damping coefficients for different values of $\gamma_L \tau_0$ ranging from 0.1 to 1 were obtained. Damped wave amplitudes are also plotted which show semiquantitative agreement with the experimental data of Malmberg and Wharton. (auth)

6768 RADIATIVE DECAY BEHIND STRONG SHOCKS. Oppenheim, Alan (Columbia Univ., Palisades, NY). Phys. Fluids; 15: No. 12, 2153-4(Dec 1972).

The effect of radiation on the state of a gas behind a strong shock is studied with a different radiation model than used by Koch and Gross. The formalism and assumptions are otherwise the same as in their paper. (auth)

6769 EFFICIENT ENERGY TRANSFER BETWEEN FAST AND SLOW ELECTRON PLASMA OSCILLATIONS. Kruer, W. L. (Princeton Univ., NJ). Phys. Fluids; 15: No. 12, 2423-6(Dec 1972).

Finite amplitude ion fluctuations are shown to efficiently and rapidly couple energy from very high phase velocity electron plasma oscillations into much slower ones and then into the particles, even when the mode coupling is off-resonant. The magnitude of the ion density fluctuation $\delta n/n_0$ which gives efficient off-resonant coupling is typically the frequency mismatch between the plasma oscillations normalized to the electron plasma frequency. Such modest level ion fluctuations are often present in plasmas or can be selectively excited. This coupling mechanism is particularly important for allowing energetic beams to rapidly transfer energy to a dense background plasma. A simple calculation shows the principal features of the off-resonant mode coupling. The predictions are then confirmed by computer simulations. (auth)

6770 LIFETIME OF PLASMA FLUCTUATIONS IN A DISCHARGE TUBE WITH TURBULENT GAS FLOW. Rhinewine, M.; Granatstein, V. L. (Bell Telephone Labs., Inc., Murray Hill, NJ). Phys. Fluids; 15: No. 12, 2445-6(Dec 1972).

A direct measurement of the lifetime of plasma density fluctuations in turbulent pipe flow was made; this measurement determines the range of validity of the frozen flow assumption in past studies of microwave scattering from plasma fluctuations. (auth)

6771 IMPROVED KORTEWEG–deVRIES EQUATION FOR ION-ACOUSTIC WAVES. Tappert, Frederick (Bell Telephone Labs., Whippany, NJ). Phys. Fluids; 15: No. 12, 2446-7(Dec 1972).

The Korteweg–deVries equation describing nonlinear ion-acoustic waves in a plasma with finite ion temperature is derived and the temperature dependences of soliton width and speed are obtained. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 6000, 6031, 6404, 6413, 6414, and 6812.

6772 (AD-741180) AIR TRANSPORT CALCULATIONS USING THE LASL-NWEF AIR FLUX TAPE AND THE NWEF COMPUTER PROGRAM, CDR. Campbell, J. E.; Sandmeier, H. A. (Naval Weapons Evaluation Facility, Albuquerque, N. Mex.). 10 Apr 1972. Contract ORD-35C-004/212-1/UF311-502. 100p. (NWEF-1090). NTIS.

The recent availability of coupled neutron-gamma, multigroup, cross-section sets has prompted the production of a neutron-gamma air flux tape similar to the neutron air flux tape reported previously. The air flux data consists of complete transport calculations in uniform, sea-level air for one-source neutrons in each of 30 energy groups and one-source photons in each of 12 energy groups. The computer program CDR (constant dose range) uses the new air flux tape to produce ranges of constant dose from a point source in the atmosphere. (auth) (GRA)

6773 (FRNC-TH-229) SIMULATION OF ELECTRON AND PHOTON TRANSPORT USING THE MONTE CARLO METHOD. Patau, Jean-Paul (Toulouse Univ. (France)). 1972. 177p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

A Monte Carlo method for studying the transport of electrons and photons in matter (under conditions compatible with the validity of the Born approximation) is presented. The slowing down of the electrons is simulated from samplings of the distributions of the angular deflections effected by Goudsmit and Saunderson, distributions of the Landau path lengths modified by Blunck-Leisegang, the Schiff cross section for the production of bremsstrahlung, and the Moller cross section for catastrophic collisions. The photon transport is simulated taking the following effects into consideration: Compton effect, Thomson effect, photoelectric effect, and materialization. The applications treated apply to semi-infinite geometrical systems, multi-laminar systems, and parallelepiped systems. The methods outlined are intended for more complex configurations and media having various compositions (inert or biological) irradiated by internal or external sources having undefined spectral compositions and directional properties. (140 references) (France)

6774 (KFK-EXT-3/72-6) PHYSICAL CONSIDERATIONS IN THE USE OF HEAVY CHARGED PARTICLES IN RADIATION THERAPY. Bueche, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Jun 1972. 22p. (In German). Dep. NTIS (U. S. Sales Only).

The physical background for the energy loss of heavy charged particles in materials such as tissue is represented. BRAGG curves for three typical particles, i.e., pions, protons, and completely ionized nitrogen atoms, are calculated. The results are discussed and compared with the depth-dose curves of γ quanta, electrons, and neutrons which have been preferably used in radiotherapy until now. Biological effects connected with living tissue are not discussed in this paper. From the point of view of physics, the negative pion is particularly suited for use in radiotherapy of deep-seated tumors. (auth)

6775 (ORNL-TM-3659(Rev.)) CALCULATIONS OF THE TRANSPORT OF NEUTRONS AND SECONDARY GAMMA RAYS THROUGH CONCRETE FOR INCIDENT NEUTRONS IN THE ENERGY RANGE 15 TO 75 MeV. Roussin, R. W.; Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 21p. Dep. NTIS.

Earlier work by Alsmiller et al. considered coupled neutron and secondary-gamma-ray transport through a thick shield of silicon dioxide with 5% water by weight for neutron sources with energies of 50, 100, 200, 300, and 400 MeV. In that work, the approximation was made that gamma rays were produced only by neutron capture. In the present work, coupled neutron and secondary-gamma-ray transport through a thick shield of concrete for neutron sources with energies of 15, 25, and 75 MeV is considered. In this study, gamma-ray production for all interactions involving neutrons with energies up to 15 MeV was included; i.e., the approximation made here is that gamma-ray production can be neglected for interactions by neutrons with energies > 15 MeV. For incident neutron energies of 15, 25, 50, and 75 MeV, results of total and gamma-ray dose equivalents are given as a function of depth into the concrete slab. For the 50- and 75-MeV incident neutron energies, the gamma-ray dose equivalent was found to be no more than 5% of the total dose equivalent at all depths considered ($\leq$1500 g/cm^2). For the 15- and 25-MeV incident neutron energies, however, the gamma-ray dose equivalent dominates at greater depths into the slab. A conservative estimate of the effect of including gamma rays produced in interactions with neutrons of energies >15 MeV indicates that the calculated total dose equivalent would increase by no more than 5%. (auth)

6776 (ORNL-TM-3985) PION DOSE CALCULATIONS. Armstrong, T. W. (Oak Ridge National Lab., Tenn.). Oct 1972. Contract W-7405-eng-26. 29p. Dep. NTIS.

The application of the Monte Carlo code HETC for performing pion-dose calculations is discussed, and several comparisons of calculated and measured depth-dose distributions induced by neutrons, protons, and negatively charged pions are presented. The use of the code to predict cell survival is also discussed. (auth)

6777 MARINER VENUS-MERCURY 1973 MISSION SOLAR PROTON ENVIRONMENT: FLUENCE AND DOSE. Thomas, J. R. (Boeing Co., Seattle). JPL Quart. Tech. Rev.; 2: No. 1, 12-28(Apr 1972).

The solar proton environment of Mariner Venus-Mercury 1973 (MVM73) may be the most severe yet encountered in space missions, because the trajectory by Mercury brings the spacecraft significantly closer to the Sun than that of any previous exploration. This study presents a derivation of proton fluence over the duration of the mission in terms of a relatively constant low-energy component, the solar wind, and a probabilistic high-energy component from discrete solar events. An updated correlation of yearly energetic proton fluence with yearly average sunspot number is presented. This correlation and sunspot cycle forecasts for the period of the MVM73 mission (late 1973 through early 1975) form the basis for the high-energy proton fluence estimates with various confidence levels. Uncertainties in the probability estimates and in calculation of the scaling with distance from the Sun are discussed. Selection of a particular 95-percentile model as the design constraint is recommended along with reasons for not using the worst-case model. Interior fluences are calculated and expressed in terms expected to be useful for spacecraft design. (auth)

6778 INVESTIGATIONS ON THE DOSE DISTRIBUTION DURING PENDULUM IRRADIATION BY MEANS OF ULTRAHARD PHOTONS (30, 35, and 42 MV) WITH THE PENDULUM AXIS NOT IN THE MIDDLE OF THE PHANTOM. Schroeter, G. Heidelberg; Heidelberg Univ. (1970). 23p. (In German).

Thesis.

Measurements using a 42-MeV Siemens betatron with pendulum angles of 120 and 180°, field widths of 6 and 8 cm, and energies of 30, 35, and 42 MeV were performed. The influence of these variables on the depth dose distribution within the phantom were determined by means of a film densitometer. (GF)

6779 RANDOM STOPPING POWER FOR PROTONS IN SILICON. Foster, C.; Kool, W. H.; Weg, W. F. V. D.; Roosendaal, H. E. (FOM Inst. of Atomic and Molecular Physics, Amsterdam). Radiat. Eff.; 16: No. 1-2, 139-40(Sep 1972).

A 120-keV proton beam was incident in a random direction on an etched silicon sample mounted in a goniometer. Detection of the backscattered protons was by a cooled surface-barrier detector. The pulses produced were registered in a 1024-channel pulse-height analyzer, from which plots were made of the backscattered energy spectra. The spectra were analyzed assuming that the protons experienced a single wide-angle Rutherford scattering event. It was concluded that the stopping power of protons incident in a random direction on silicon is constant for backscattered energies of 30 to 110 keV and has a value of 11.6 ± 0.5 eV/Å. The result is found to be consistent with other published work. (UK)

6780 CALCULATION OF THE ENERGY DEPOSITED BY FISSION FRAGMENT SPECTRUM. Koo, V. L.; Mulas, P. (Instituto Nacional de Energia Nuclear, Mexico City). Trans. Amer. Nucl. Soc.; 15: No. 2, 720(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6781 UNIFIED THEORY OF MULTIGROUP TRANSPORT CROSS SECTIONS. Harris, D. R. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 958(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6782 BOUNDARY DOSE RATES DUE TO GAMMA RAYS AT POWER REACTOR SITES. Wells, M. B. (Radiation Research

Associates, Fort Worth, Tex.); Collins, D. G.; Neuendorf, W. P. Trans. Amer. Nucl. Soc.; 15: No. 2, 973-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6783 CALCULATION OF THE ABSORBED DOSE AND DOSE EQUIVALENT FROM NEUTRONS AND PROTONS IN THE ENERGY RANGE FROM 3.5 GeV TO 1.0 TeV. Chandler, K. C.; Armstrong, T. W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 976-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6784 GAMMA-RAY AND ELECTRON TRANSPORT BY MONTE CARLO. Thompson, W. L. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 15: No. 2, 978(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6785 DIRECTIONAL-BIASING SOLUTION FOR RADIATION TRANSPORT. Harms, A. A.; Garland, W. J. (McMaster Univ., Hamilton, Ont.). Trans. Amer. Nucl. Soc.; 15: No. 2, 978-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6786 RADIATION TRANSPORT IN A HALFSPACE WITH A SOURCE EXTERNAL TO THE MEDIUM. Pomraning, G. C. (Science Applications, Inc., La Jolla, CA). Nucl. Sci. Eng.; 49: No. 4, 409-17(Dec 1972).

The transport of radiation in a halfspace, due to a source external to the medium, is analyzed. This situation arises in certain radiation transport studies. In particular, in the diffusion description, the correct two-dimensional solution is compared with a commonly used series of one-dimensional approximations. The results should be of help in determining, for a given problem, whether a full multidimensional transport calculation is required or if the one-dimensional approximation is adequate. In the case of radiative transfer, it is shown that a one-dimensional treatment is in general not adequate. (auth)

6787 DISTRIBUTION OF QUALITATIVE COMPOSITION AND ABSORBED DOSES OF ^{60}Co GAMMA-RADIATION WHEN USING LATTICE FILTERS. Nguyen van Thien; Zaboronskii, A. A.; Krongauz, A. N.; (and others) (Moscow Scientific-Research Rentgeno-Radiological Inst.). Med. Radiol.; 17: No. 10, 70-4 (Oct 1972). (In Russian).

Distribution of effective energies and absorbed-doses of γ-emission in the phantom when employing lattice filters has been studied by two detectors with different "energy dependence". With increase of depth the effective energy diminishes and at the depth of 15-20 cm it is 400-500 KeV. With greater distance from the emission source surface to the phantom the effective energy in the open field and under the holes of the lattice decreases. The index of dose inhomogeneity depends on the emission source surface distance decreasing with its increased distance. (auth)

6788 SIGNIFICANCE OF MULTIPLE INELASTIC SCATTERING IN SCANNING ELECTRON MICROSCOPY CHANNELLING PATTERNS. Spencer, J. P.; Humphreys, C. J. (Oxford Univ.). pp 500-1 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From 5th European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

The treatment of the problem of a fast electron incident on a bulk specimen of a crystalline solid is discussed. This requires consideration of three distinct effects: diffraction of the incident electron by crystal planes, including anomalous "absorption" effects, multiple inelastic scattering, and the effect of energy loss. Investigations so far have been concentrated almost entirely on effects associated with the initial diffraction, and multiple inelastic scattering and energy loss have either been ignored or treated in a very crude fashion. The present paper concentrates on the significance of multiple inelastic scattering in channelling patterns. (UK)

Radiation Source Calibration and Standardization

Refer also to abstract 5493.

Shielding Calculations and Experiments

Refer also to abstracts 5812 and 6784.

PHYSICS (SOLID-STATE)

Radiation Effects

Refer also to abstracts 5091, 5109, 5390, and 6788.

6789 (AD-743134) STUDIES OF RADIATION DAMAGE IN SEMICONDUCTORS. Annual Report, May 1, 1971-April 30, 1972. Corbett, J. W. (State Univ. of New York, Albany. Research Foundation). 30 Apr 1972. Contract N00014-70-C-0296. 22p. NTIS.

The work is divided into three areas: (1) EPR measurements on silicon and diamond; (2) optical and electrical measurements on silicon and diamond; and (3) theoretical work on these materials and their defect structures, including the nature of the amorphous state. (auth) (GRA)

6790 (N-72-24836) EFFECTS OF SIMULATED SPACE RADIATION ON SELECTED OPTICAL MATERIALS. Nicoletta, C. A.; Eubanks, A. G. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). May 1972. 17p. (NASA-TN-D-6758). NTIS.

The effect of simulated Nimbus spacecraft orbital (1100 km, circular, and polar) radiation on wide-bandpass glass filters, narrow-bandpass thin-film interference filters, and several fused silicas was determined by transmittance measurements over the 200 to 3400 nm wavelength region. No changes were observed in the filters, which were shielded with fused silica during irradiation, after exposure to a 1-year equivalent orbital dose of electrons, nor in the fused silicas after the same electron exposure plus a 1-year equivalent dose of protons. Exposure to a ½-year equivalent dose of solar ultraviolet radiation caused a significant degradation in the transmittance of two ultraviolet-transmitting interference filters but had no effect on two colored glass filters that transmitted in the visible and near-infrared regions. As a result of the ultraviolet exposure, the fused silicas exhibited losses of several percent over the 200- to 300-nm wavelength region. (auth) (STAR)

6791 RADIOLUMINESCENCE OF Al_2O_3. Bagdasarov, Kh. S.; Vakhidov, Sh. A.; Khatamov, L. R.; Yunusov, M. S.; K Khaimov-Mal'kov, V. Ya. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 81-2(1972). (In Russian).

The influence of irradiation temperature on the supplementary absorption bands and the radioluminescence of ruby was studied. Ruby samples were excited with the gamma field of a ^{60}Co source. Cr amounts from 10^{-3} to 0.5% had been added to the Al_2O_3 as an activator. Samples irradiated at room temperature and then at -196°C noticeably faded with the second irradiation; a radiation "annealing" of the induced coloration occurred. (K.S.W.)

6792 DIELECTRIC DISPERSION OF IRRADIATED $BaTiO_3$ NEAR THE PHASE TRANSITION. Demyanov, V. V.; Solov'ev, S. P. Rev. Phys. Appl.; 7: No. 2, 81-2(Jun 1972).

Samples of polycrystalline $BaTiO_3$ were irradiated in-pile with integrated neutron fluxes up to $\phi = 5 \times 10^{19}$ cm^{-2}. The dielectric permeability and dielectric losses occurring were measured up to a frequency of 1.5×10^{10} Hz. A sharp increase in the dispersion frequency f_0 and the state transformation induced by the irradiation was observed for a flux $\varphi_c \cong 5 \times 10^{18}$ cm^{-2}, these changes corresponding to a maximum in the ϵ vs ϕ curve. The qualitative variations observed for ϵ and f_0 are analogous to those of the same parameters in the region of the Curie point for nonirradiated $BaTiO_3$. When $\varphi < \varphi_c$, the shift in the Curie point for lower temperatures depends upon the frequency: $\Delta T_c(f) = \Delta t_0 \times \ln(f_0'/f)$, where $\Delta t_0 = 4$ to 5°C and f_0' is $\cong 10^{11}$ Hz. (France)

6793 DIELECTRIC BEHAVIOR OF MONOCRYSTALS OF $BaTiO_3$ IRRADIATED WITH FAST NEUTRONS. Quittet, A. M.; Lambert, M. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 2, 141(1972). (In French).

When tetragonal barium titanate crystals are irradiated with fast neutrons, they become cubic, and their ferroelectric characteristics disappear. Experiments were performed in which the ferroelectric behavior of such crystals when subjected to neutron fluxes of between 1×10^{18} and 10^{20}n/cm^2 were systematically examined: dielectric constant, spontaneous polarization, and structural characteristics. X-ray diffraction techniques were used. (France)

6794 INDIUM-ZINC IMPLANTED GALLIUM ARSENIDE DIODES. Monteith, L. K. (North Carolina State Univ., Raleigh); Littlejohn, M. A.; Hauser, J. R.; Hendricks, H. D. Radiat. Eff.; 16: No. 1-2, 133-4(Sep 1972).

N-type ⟨111⟩ oriented gallium arsenide substrates with carrier concentrations of 5×10^{16} cm^{-3} have been implanted with 10^{17} cm^{-2} indium ions to convert the implanted region to gallium-indium-arsenide. Subsequently 10^{14} cm^{-2} zinc ions were implanted to yield a p-n junction. The electrical and optical properties of the indium-zinc implanted gallium arsenide were compared to a gallium arsenide substrate implanted only with zinc, and the results indicate that the indium-zinc implant yields a p-n junction with a portion of the diode a gallium-indium-arsenic alloy. (auth)

6795 CHANNELING AND BLOCKING ALONG POLAR LATTICE DIRECTIONS. Edge, R. D.; Varelas, C.; Sizmann, R. (Univ., Munich). Radiat. Eff.; 16: No. 1-2, 95-9(Sep 1972).

Calculations show that the critical angle for channeling is unaffected in the two opposite directions of polar strings -AB-AB-, where A and B are different atoms. However, there is a significant difference in critical angles for blocking. The region where ions are no longer well channeled, but are not necessarily immediately lost from the channel shows an unusual distribution of reflected ions. A distinguishable difference in the rate of dechanneling in the two directions is anticipated. The calculations show that the location of substitutional foreign ions may be identified uniquely using the blocking pattern given by these ions. (auth)

6796 ANNEALING BEHAVIOR OF THE 7070 A COLOR CENTER AND ESR SPECTRUM IN IRRADIATED NAPHTHALENE CRYSTALS. Piccini, A. (Univ., Sao Paulo, Brazil); Whitten, W. B. Mol. Cryst. Liquid Cryst.; 18: No. 3-4, 333-7(Oct 1972).

The annealing characteristics of the optical absorption at 7070 Å and the ESR spectrum in x-ray irradiated naphthalene crystals were studied. The color center decays exponentially during isothermal annealing while the ESR spectrum exhibits a second-order bimolecular decay. Thermal activation energies for the two decays are 1.1 ± 0.2 eV and 0.9 ± 0.2 eV, respectively. (auth)

6797 RADIATION F-CENTER PRODUCTION IN LiF AT AND ABOVE ROOM TEMPERATURE. Sonder, E.; Templeton, L. C. (Oak Ridge National Lab., TN). Radiat. Eff.; 16: No. 1-2, 115-25(Sep 1972).

Radiation defect production in LiF was measured at and above room temperature as a function of dose, dose rate, temperature, impurity content, and pre-irradiation sample deformation. Emphasis was placed on the growth rate of the 250-nm F band and the ratio α_{445}/α_{F1}, where α_{445} is the absorption coefficient at the peak of the 445-nm F-aggregate band. Comparison of the behavior of LiF with that of KCl indicates that the dose rate and temperature dependences of LiF can be accounted for in terms of the mobility of the F^+ center (negative ion vacancy containing no electron) in the same way as they are for KCl and other alkali halides. On the other hand, the effect of trace impurities on the defect production rate appears to be different in LiF than in KCl. For example, among several impurities only Mg produces a significant increase in the F-center production efficiency. Also, no rapidly saturating early stage coloration can be observed for any impurity. (auth)

6798 TRANSMISSION PROFILES IN HIGH-ENERGY ELECTRON CHANNELING. Schiebel, U.; Neufert, A.; Clausnitzer, G. (Institut fuer Kernphysik, Giessen, Ger.). Phys. Lett.; 42A: No. 1, 45-6(6 Nov 1972).

Monte Carlo computer calculations have shown that transmission profiles in high-energy-electron channeling can be well understood by regarding the direct influence of the string-effect on the electron scattering angle. (auth)

6799 OSCILLATING TRAJECTORIES IN PLANAR CHANNELING STUDIED BY BACKSCATTERING FROM IRON CRYSTALS. Abel, F.; Amsel, G.; Bruneaux, M.; Cohen, C. (Ecole Normale Superieure, Paris). Phys. Lett.; 42A: No. 2, 165-6(20 Nov 1972).

Backscattering experiments with 1.9-MeV helium ions were performed to study the oscillating trajectories of particles in planar channels of iron crystals. Strong maxima in the planar aligned spectra were observed. A stochastic model yields a good fit to the experimental results. (auth)

6800 EXISTENCE OF A STABLE INTERSTITIAL IN GOLD AT ~300 K. Daoud, M.; Kachoukh, N.; Lucasson, A.; Lucasson, P. (CNRS, Orsay, France). Phys. Lett., 42A: No. 2, 169-70 (20 Nov 1972).

The resistivity increase versus electron flux in gold electron irradiated at ~120°K after adequately slow quenches was measured. The existence of a plateau on the experimental curves is interpreted with regard to the two-interstitial model. (auth)

6801 CHANNELING OF CHARGED PARTICLES IN PERFECT CRYSTALS. Pathak, A. P.; Yussouff, M. (Indian Inst. of Tech., Kanpur). Radiat. Eff.; 16: No. 1-2, 1-6(Sep 1972).

The quantum-mechanical formalism for anomalous transmission of particles through perfect crystals using Debye model for lattice vibrations as described in an earlier work, (Phys. Rev., B2: 4723(1970)) is applied to the case of Born–Mayer potential as the interaction between the incident particles and the lattice atoms. The results are compared with those obtained by using the screened Coulomb potential in the earlier work. The dependence of the process on the incident particle energy and the crystal temperature is established and is found to be similar to that obtained earlier. The channeling parameter $(1-\epsilon)$ is found to depend upon the charge number z_1 of the incident particle (decreases with increasing z_1) in contrast to the results obtained with the screened Coulomb potential where $(1-\epsilon)$ depends only upon the screening properties of the electrons in the crystal. (auth)

6802 DISPERSION OF TRANSURANIUM ELEMENTS BY FISSION FRAGMENTS. Aleksandrov, B. M.; Baranov, I. A.; Krivokhatskii, A. S.; Tutin, G. A. At. Energ. (USSR); 33: No. 4, 821-4(Oct 1972). (In Russian).

The dispersion of atoms from thin layers of transuranium compounds by fission fragments was investigated. The source of fragments was ^{252}Cf and the dispersed isotopes ^{238}Pu, ^{239}Pu, and ^{241}Am. The number of atoms dispersed by one fragment is 10^2 to 10^3. It was established that the greater the energy of the fragment the more it disperses atoms from a given thin layer of matter. The lower limit of the number of dispersed atoms along the fragment path was estimated at $\sim 10^6$ atoms. The data obtained cannot be explained only by elastic interactions of fragments with the given atoms. It seems possible to relate the dispersion mechanism, and hence radiation damage, to the specific ionization loss of fragments along their path. (auth)

6803 THRESHOLD SHIFT CALCULATIONS FOR ION IMPLANTED MOS DEVICES. MacPherson, M. R. (National Semiconductor Corp., Santa Clara, CA). Solid-State Electron.; 15: No. 12, 1319-26(Dec 1972).

The solutions of Poisson's equation applicable to ion-implanted MOS devices were used to generate capacitance–voltage relationships for capacitors and threshold voltage shifts for transistors. The calculations agree well with previously published transistor data for profiles centered near $Si-SiO_2$ interface. These shallow implants (<0.1 μm) are easily controlled by the gate and yield voltage shifts equal to that expected for all of the charge lumped at the silicon surface. In addition, the observed saturation of gate voltage shift for deeper implants in enhancement-mode transistors can be duplicated by the calculations provided that the stopping power of SiO_2 is reduced as has been proposed elsewhere. Further, it was predicted that gate control will be lost for depletion-mode transistors with sufficiently deep implants. This is caused by the formation of a deep channel which is isolated from gate control by an induced surface-charge layer. The inability of the gate field to pinch off the channel defeats use of the device for transistor inverter loads. (auth)

6804 FACILITY FOR REACTOR IRRADIATIONS OF METALS AT 78°K. DOSE AND RECOVERY CURVES OF ELECTRICAL RESISTIVITY. Papathanassopoulos, K.; Olympios, E.; Rocofyllou, E.; Andronikos, P.; Boening, K. (Democritus Nuclear Research Center, Athens). Radiat. Eff.; 16: No. 1-2, 33-43(Sep 1972).

A liquid nitrogen irradiation loop was installed at the research reactor of N.R.C. "Democritus" in Athens. In this facility metals can be irradiated with fast neutrons at 78°K. Electrical resistivities can be measured during irradiation. The irradiation facility as well as the electrical resistivity measuring cryostat, which allows annealing of the samples in the temperature range of 78 to 650°K, are described. The annealing spectra of neutron irradiated Cu, Ni, Al, Fe, and Fe(Si,C) were measured in order to prove the performance of the system and to get new recovery data mainly in the high temperature range. The details of these spectra are discussed with more emphasis on the fine structure to be seen. Stage II of Cu and Ni shows four well separated substages indicating a rather complex recovery process. (auth)

6805 PRODUCTION OF IONIZED WATER CLUSTERS BY ELECTRON BOMBARDMENT OF ICE. Floyd, G. R.; Prince, R. H. (York Univ., Toronto). Nature (London) Phys. Sci.; 240: No. 97, 11-12(6 Nov 1972).

The generation of water clusters on the surface of ice films by low-energy electron bombardment is reported. The experimental work was performed in a high-vacuum system equipped with a cryostat to which was attached a gold-plated Cu target. Electrons at 80 eV were directed at the target on which water was continuously deposited at a low rate after establishing a film of adequate thickness to eliminate interactions with the gold substrate. The ionized water clusters produced were analyzed by a quadrupole mass filter and detected by a channel electron multiplier. Experiments were conducted at 193 and 153°K, and the clusters corresponded to $H^+(H_2O)_n$, where $3 \leq n \leq 8$. It was found that the lower the temperature the thinner the ice film must be to obtain successful results; experiments at 77°K were unsuccessful. The question of how the clusters are produced on the lattice surface and are able to escape in an ionized state is discussed, along with the surface charging effect, which increases the potential barrier for escape, and is particularly notable with thick films. The decrease in intensity at lower temperatures is attributed to the combined effects of reduced lattice conductivity and enhanced electron trapping. (UK)

6806 ANNEALING OF HEAVY ION IRRADIATION DAMAGE IN GALLIUM ARSENIDE. Pritchard, W. M. (Old Dominion Univ., Norfolk, Va.). Trans. Amer. Nucl. Soc.; 15: No. 2, 732-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6807 ESR STUDY OF A DI-INTERSTITIAL CENTER IN ELECTRON IRRADIATED NaF:Li^+. Plant, W. J. (Naval Research Lab., Washington, DC). Solid State Commun.; 11: No. 9, 1219-22(1 Nov 1972).

An ESR study of electron-irradiated NaF : Li^+ shows that a center consisting of an F_3^{2-} molecule ion stabilized by a lithium impurity is formed at 77°K. The F_3^{2-} molecule ion replaces an F^- ion in the lattice, thus forming a di-interstitial center. (auth)

6808 EFFECT OF ULTRAVIOLET IRRADIATION ON CaF_2 CONTAINING TRIVALENT RARE EARTH-INTERSTITIAL HYDRIDE ION PAIRS. Ashburner, I. J.; Newman, R. C. (Univ. of Reading, Eng.). J. Phys., C (London); 5: No. 21, L283-6 (31 Oct 1972).

CaF_2 crystals containing $RE^{3+}-H_i^-$ pairs of C_{4v} symmetry were irradiated by uv light and x rays at 77°K. These treatments destroy the C_{4v} centers and produce new centers which are believed to have trigonal symmetry. The new centers are unstable on warming the samples to about 130°K when the original tetragonal centers are reformed. (auth)

6809 TSC STUDY OF TRAPS IN ELECTRON-IRRADIATED TEFLON AND POLYETHYLENE. Perlman, M. M.; Unger, S. (College Militaire Royal, Saint-Jean, Quebec). J. Phys., D (London); 5: No. 11, 2115-23(Nov 1972).

Thermally stimulated currents (TSC) were measured from Teflon (PTFE) and polyethylene irradiated in vacuum with low-energy (6 keV) electrons at −180°C. The spectra from both materials are virtually identical and consist of seven overlapping peaks. Each material contains at most three different traps in spite of the larger number of peaks. All of the trap energies and escape frequencies were determined for PTFE and a number of them for polyethylene. The results suggest that there are different structural locations in a material for the same type of trap, and that differences in peak positions are due to different degrees of molecular motion. No peaks are observed from either material above 0°C. Previous work has shown a large number of peaks above 0°C from corona-charged specimens. This and other results show that the long-term stability of corona-charged electrets must be attributed to ion trapping rather than electron trapping. (auth)

6810 ELECTRON PARAMAGNETIC RESONANCE STUDIES OF X-IRRADIATED KH_2AsO_4, KD_2AsO_4, RbH_2AsO_4, RbD_2AsO_4, CsH_2AsO_4, $NH_4H_2AsO_4$, AND $ND_4D_2AsO_4$ (FERROELECTRICS AND ANTIFERROELECTRICS). Dalal, N. S.; Dickinson, J. R.; McDowell, C. A. (Univ. of British Columbia, Vancouver). J. Chem. Phys.; 57: No. 10, 4254-65(15 Nov 1972).

Electron paramagnetic resonance (EPR) studies of defect centers produced by x or γ irradiation of the hydrogen-bonded ferroelectrics KH_2AsO_4, KD_2AsO_4, RbH_2AsO_4, RbD_2AsO_4, and CsH_2AsO_4 and of the antiferroelectrics $HN_4H_2AsO_4$ and $ND_4D_2AsO_4$, are presented. The spectra, observed over 300 to 4.2°K, are characterized by a very large hyperfine interaction of the unpaired electron with the ^{75}As ($I = \frac{3}{2}$) nucleus, and exhibit orthorhombic symmetry in general. The analysis thus required an exact diagonalization of the spin Hamiltonian. Such a procedure, coupled with the use of the method of least-squares adjustment, has resulted in accurate values for the hyperfine parameters describing the observed spectra, both for single crystal and powder samples. A comparison of the hyperfine parameters with those reported previously for the AsO_4^{4-} in KH_2AsO_4 enabled the identification of lines from this center in all the above crystals. The parameters are found to be sensitive to change of the cation

and also to a variation of the sample temperature. This indicates that EPR can be used as a microscopic probe for studying hydrogen bonding and the proton–lattice motion in these compounds. An observed hydrogen–deuterium isotope effect on the hyperfine parameters is also discussed. Absence of proton superhyperfine for AsO_4^{4-} in RbH_2AsO_4, and CsH_2AsO_4 is discussed in the light of preliminary ENDOR experiments on RbH_2AsO_4. Accurate values were also obtained for the spin Hamiltonian parameters of several other centers which show fairly similar spectra, for both the high- and low-temperature phases. Here also the ^{75}As hyperfine parameters show isotope effects, both for the change of the cation and for the substitution of D in place of H. All these centers are assigned to a family of AsO_3^{2-} centers. A previously reported proton superhyperfine structure, which cast strong doubt on the identification of these centers, was not observed. This lends further support to the assignment. Possible mechanisms for the formation of these centers are discussed, but no definite answer could be obtained through these studies alone. (auth)

6811 STUDY BY ELECTRON MICROSCOPY OF NEUTRON DAMAGE IN ZIRCONIUM AND ZIRCALOY-2. Riely, A.; Grundy, P. J. (Univ. of Salford, Eng.). Phys. Status Solidi (a); 14: No. 1, 239-47(16 Nov 1972).

An electron microscope study of the microstructural changes occurring in iodide zirconium (pure zirconium) and the alloy Zircaloy-2 after irradiation to 10^{20} neutrons cm^{-2} at temperatures in the range 200 to 400°C is described. Specimens in both the annealed and cold-worked state before irradiation are examined, and the influence of pre-irradiation treatment on the resulting microstructure is discussed. Comparisons of defect densities are made along with attempts at crystallographic analysis of the larger loop defects formed during 400°C irradiation. These loops are suspected of lying mainly on pyramidal planes and of having Burgers vectors of the type $\frac{1}{3}\langle 11\bar{2}0\rangle$ and $\frac{1}{3}\langle 11\bar{2}3\rangle$, although for some loops other values must also be considered to fit the contrast observations. Other results suggest the significance of $\{11\bar{2}5\}$ planes in the slip systems of zirconium as evidence has been found for dislocation movement and loop growth on these planes. (auth)

6812 WAVE-PARTICLE DUALITY IN DIFFRACTION AND CHANNELLING BY CRYSTALS. Humphreys, C. J. (Oxford Univ.). pp 460-1 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From 5th European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

The controversy concerning the particle-versus-wave models for describing the propagation of fast charged particles through crystals is discussed. In the classical particle model, particle channelling between rows and planes of atoms is characterized by a critical angle ψ_c and the concept of Bragg reflection does not enter this model. On the other hand, the wave model predicts a Bloch wave channelling effect that is related to the Bragg angle θ_B and in which the critical angle ψ_c does not feature. It is shown that various aspects of the paradox may be very simply solved. The standard diffraction equations may be solved analytically when an infinite number of Bloch waves and diffracted beams are considered, and when inelastic scattering is taken into account phenomenologically by making the crystal potential complex. (UK)

6813 REDUCED RADIATION DAMAGE OF HALOGENATED COPPER-PHTHALOCYANINE. Uyeda, N. (Kyoto Univ., Uji, Japan); Kobayashi, T.; Ohara, M.; (and others). pp 566-7 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From 5th European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

In the course of electron microscope studies of organic crystals with regard to epitaxial growth it was found that Cu-hexadecachlorophthalocyanine (wholly chlorinated Cu-phthalocyanine) is remarkably resistant to radiation damage in the microscope. This led to a comparative study of the radiation resistance of the chlorinated compound as against the unchlorinated compound in the electron microscope at various accelerating voltages and specimen temperatures. The specimens were thin crystalline fibres prepared by epitaxial growth in an ultrahigh vacuum evaporator. The chlorinated compound was found to be 20 to 30 times as radiation resistant as the unchlorinated compound at 100 kV. The effect of specimen temperature is shown graphically. The final damage appears to be controlled by chemical reaction after irradiation, which has a strong influence on the C—H bonding of ordinary phthalocyanines. (UK)

6814 APPLICATION OF HIGH-VOLTAGE ELECTRON MICROSCOPY TO RADIATION DAMAGE STUDIES IN CRYSTALS AT 8 TO 300°K. Urban, K. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 568-9 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From 5th European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

A high-voltage electron microscope equipped with a high-resolution cooling stage provides a novel facility for low-temperature radiation damage studies. Thin Ni foils were irradiated at 8°K with 650-keV electrons and the agglomeration of point defects in the temperature range 8 to 300°K observed. A dose of about 5×10^{20} e/cm^2 was necessary to produce a visible defect structure, and the damage appeared as irregularly shaped spots of 10 to 50Å diameter. Diffraction patterns of a sample before and after irradiation are shown, and the observed contrast is discussed. It appeared that the defect clusters represented regions of disorder but nevertheless maintaining the essential features of the lattice symmetry, and that the disordered regions contained only moderate defect densities, allowing the lattice to relax partially between the defects. A high density of single point defects appeared to be present in addition to the agglomerates. Annealing of the samples up to 300°K produced additional defect clusters, and at 300°K clusters well separated were identified as dislocation loops. (UK)

6815 IN SITU OBSERVATION OF A RADIATION INDUCED PHASE TRANSFORMATION. Flower, H. M.; Swann, P. R. (Imperial Coll. of Science and Tech., London). pp 570-1 of Electron Microscopy 1972. London; Inst. of Physics (1972).

From 5th European congress on electron microscopy; Manchester, England (5 Sep 1972). See CONF-720913.

Radiation-induced displacement damage was investigated both in reactor environments and, more recently, in the high-voltage electron microscope. The studies were mainly concerned with the production of vacancies and interstitials, and their aggregates, within stable crystalline phases. In principle, however, it should be possible for radiation to displace atoms from metastable into more stable sites either by enhancing the local diffusion rate or by direct displacement. In the studies described, four metastable Ti alloys were irradiated in a high-voltage microscope and their phase transformations studied in the foregoing context. (UK)

6816 ELECTRON MICROSCOPIC INVESTIGATION OF RADIATION DEFECTS FROM THE IRRADIATION OF ALKALI HALIDES WITH AN ELECTRON BEAM AND WITH ULTRAVIOLET RADIATION. Iygi, Kh. R. V. (Inst. of Physics and Astronomy, Tallin, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 9, 1990-3(Sep 1972). (In Russian).

Crystals of KBr at 450°K were exposed to a 5-second dose of electrons (total of 10^{12} e/cm^2), or alternatively, to 6.9-eV photons (total of 5×10^{13} quanta/cm^2) at room temperature. After decorating the crystals lightly with gold, they were examined with an electron microscope. The density of the microcrystals of gold was studied as a function of the time of exposure to either electrons or photons. (K.S.W.)

6817 EFFECT OF CHANNELING ON POSITRON ANNIHILATION IN SINGLE CRYSTALS. Vorobev, S. A.; Tsekhanovskii, I. A. (Tomsk Polytechnical Inst., USSR). Phys. Status Solidi (a); 14: No. 1, K89-90(16 Nov 1972).

An experimental study was made of the channeling effect on the radiation yield of the two-quantum positron annihilation in NaCl single crystals. The angular variation of the 150°-scattered positrons and the annihilation quanta showed a dip in both curves when the incident beam was parallel to the ⟨100⟩ axis. This is in agreement with channeling theory. (D.L.C.)

6818 BLEACHING OF COLOR CENTERS IN MANGANESE-DOPED CaF_2 SINGLE CRYSTALS IRRADIATED WITH X RAYS. Agrawal, M. D.; Rao, K. V. (Indian Inst. of Tech., Kharagpur). Phys. Status Solidi (a); 14: No. 1, 217-20(16 Nov 1972).

Thermal bleaching characteristics in the range 30 to 500°C of the optical absorption bands in x-ray-irradiated manganese-doped CaF_2 (with 1 and 5 mol % of manganese content) are analysed; also the uv bleaching of CaF_2:Mn (5%) with light of 300 nm is examined. The thermal bleaching of color centers in CaF_2:Mn (1%) is considerably different from that in CaF_2:Mn (5%). In the latter sample, it is observed that the uv bleaching of absorption bands is different from thermal bleaching. Possible mechanisms explaining the difference in the bleaching of color centers in these samples are discussed. (auth)

6819 CONDUCTIVITY AND STIMULATED EMISSION IN CdS UNDER INTENSE ELECTRON BEAM EXCITATION. Bille, J.; Bojnicic-Kninski, St. v.; Ruppel, W. (Univ., Karlsruhe, Ger.). Phys. Status Solidi (a); 14: No. 1, 141-5(16 Nov 1972).

In CdS single crystals, both conductivity and luminescence were investigated under intense electron-pulse excitation with 215-keV

electrons at 120°K and at room temperature. The electron current density was varied between 0.2 and 20 A/cm^2. At high excitation (> 5 A/cm^2), the photocurrent at 120°K saturates and increases again at even larger generation rates. The saturation is accompanied by the onset of stimulated emission. The connection between current saturation and the stimulated emission as well as the conductivity increase beyond the saturation range is discussed. (auth)

6820 POINT-DEFECT PRODUCTION IN ELECTRON-IRRADIATED MOLYBDENUM. Rizk, R.; Vajda, P.; Maury, F.; Lucasson, A.; Lucasson, P. (CNRS, Orsay, France). Phys. Status Solidi (a); 14: No. 1, 135-40(16 Nov 1972).

Thin foils of 99.95% pure molybdenum were irradiated with monoenergetic electrons in the energy range 0.85 to 1.70 MeV at a temperature ≤ 8°K. Defect production was measured by monitoring the resistivity change rates per incident electron. By extrapolation, an apparent threshold energy for atomic displacement was determined to (30^{+1}_{-3}) eV. The annealing behavior of molybdenum was investigated after bombardments with 0.95- and 1.7-MeV electrons. A model for the stage I recovery of the induced point defects is presented and compared with that proposed by Afman in a recent study. (auth)

6821 FORMATION AND ANNEALING OF ISOLATION REGIONS IN SILICON THROUGH Si^+ BOMBARDMENT. Schwuttke, G. H. (IBM Corp., Hopewell Junction, NY); Brack, K.; Gorey, E. F.; (and others). Phys. Status Solidi (a); 14: No. 1, 107-13 (16 Nov 1972).

It is shown that 1-MeV Si^+ bombardment of silicon can produce subsurface amorphous insulating layers with a fixed lower boundary and a variable upper boundary. The lower boundary is determined by the ion energy and is 1.5 μm for 1 MeV. The position of the variable upper boundary depends on the ion dose and can reach the surface. The amorphous layer has insulating properties for annealing temperatures up to 500°C. After a 600°C anneal, the amorphous silicon transforms into quasi-single crystal silicon, which is infested with stacking faults and twins on a submicroscopic scale. The transformation correlates with a drop in spreading resistance from 10^7 to 10^4 Ω. After an 800°C anneal, the spreading resistance of the quasi-single crystal silicon approaches the unbombarded bulk resistance. (auth)

6822 EFFECT OF THE SPATIAL DISTRIBUTION OF ELECTRON AND HOLE CENTERS ON PHOTOSTIMULATED-LUMINESCENCE CHARACTERISTICS. Martynovich, E. F.; Parfianovich, I. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 3, 301-4(Mar 1972).

Translated from Opt. Spektrosk.; 32: No. 3, 570-5(Mar 1972).

A method was developed for changing the spatial distribution of electron and hole defects in alkali-halide crystals activated with mercury-like ions. The effect of the spatial distribution of F and Tl^{2+} centers on the temperature dependence of photostimulated F-center activator luminescence and its kinetics during short-time pulsed excitation (10^{-7} sec) were investigated. The ratio of the populations of the excited $^3P_1$ and $^3P_0$ levels of the impurity Tl^+ ions during recombination excitation was found to depend on the spatial distribution of electron and hole defects. (auth)

6823 F-CENTRE ACCUMULATION KINETICS IN KCL:Li CRYSTALS. Alybakov, A. A.; Dzhumadylov, K. (Inst. of Physics and Mathematics, Frunze, USSR); Phys. Status Solidi (b); 54: No. 1, K73-5(1 Nov 1972).

Pure and doped (0.001 to 4 mole % Li) KCl crystals were x irradiated and the absorption coefficient measured vs irradiation time. Two stages were observed, a fast growth of F centers at the beginning followed by a slow linear increase. The curves were decomposed into their components. The Li impurity increases the efficiency of F-center production in KCl, owing to the formation of cation vacancies which reduce the electron-hole recombination probability. Li also increases the stability of the F centers, as shown by optical bleaching experiments. (D.L.C.)

Physical Properties

Refer also to abstract 6097.

6824 REFLECTION OF $Eu_{1-x}Gd_xO$ SINGLE CRYSTALS IN THE VISIBLE AND INFRARED SPECTRA. Samokhvalov, A. A.; Skornyakov, G. P.; Loshkareva, N. N.; (and others) (Inst. of Metal Physics, Sverdlovsk, USSR). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 5, 1177-80(Nov 1972).

Translated from Fiz. Tverd. Tela; 14: No. 5, 1369-73(May 1972).

The reflection coefficient for $Eu_{1-x}Gd_xO$ single crystals, where $0 \leq x \leq 0.07$, was investigated in the wavelength range 0.4 to 23 μ (up to 45 μ for some samples) and in the temperature range 110 to 300°K. The results in the long-wave region for samples having $x \gtrsim 0.015$ are described satisfactorily on the basis of dispersion equations of the complex permittivity, taking account of the free-carrier and lattice contributions. A reflection peak was detected whose position changes with Gd concentration, evidently corresponding to the transition from $4f^7$ levels to donor levels of Gd^{3+} ions. Conclusions are drawn concerning the band nature of conductivity in the compounds under investigation. (auth)

6825 CATALYSIS AND THE INTERSTITIAL-ELECTRON MODEL FOR METALS. I. THE HYDROGEN-ELECTRODE REACTION AND THE KITA CLASSIFICATION OF GROUP IB AND IIB METALS. Johnson, O. (Hokkaido Univ., Sapporo). J. Res. Inst. Catal., Hokkaido Univ.; 19: No. 3, 152-66(1971).

A basis in metal structure is given for the classification by KITA of Cu, Ag, and Au along with transition metals as "d-metals" and of Zn, Cd, Hg, Ga, In, Tl, and Sn as "sp-metals." The structural basis is the known distortion of the metal ion cores (d^{10}-electron shells) of the latter group of metals which accompanies the observed lattice distortions and which leads to abnormally large screening of the ion cores by d-electrons in the direction perpendicular to the metal surface. Other properties of metals which show a difference in transition metals and "sp-metals" or a sharp discontinuity in properties between Group IB and IIB are chemisorption of xenon, gradations in mp, bp, and heat of atomization, work function, intermetallic distances, d^{10}-s promotion energy and gradation in internuclear distances of diatomic hydrides. Thus, the characterization of these Group IIB, IIIB, and IVB metals as metals with weak positive fields perpendicular to the surface but strong positive fields in the lateral direction explains a large number of anomalous properties of these metals. This asymmetric positive field may also account for the electrochemical mechanism involving H_2^+ as an intermediate as proposed by HORIUTI for Group IIB, IIIB, and IVB metals (sp-metals) rather than the H atom intermediate involved for Group IB and transition metals (d-metals). The different dependence of reaction rate on pH and other secondary factors for the two groups of metals is also discussed. (auth)

6826 ELECTRONIC AND ANOMALOUS CONTRIBUTION TO THE LOW-TEMPERATURE HEAT CAPACITY OF ZIRCONIUM CARBIDE. Ganenko, V. E.; Bykov, A. M. (Donetsk Physical-Technical Inst., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 9, 1546-8(Sep 1972). (In Russian).

The heat capacity of $ZrC_{0.95}$ was investigated in the temperature region from 5 to 350°K and was found to be related to the characteristic Debye temperature and the electron structure of the compound. In an analysis of the lattice contributions to the heat capacity of $ZrC_{0.95}$, an anomalous contribution was discovered and its temperature dependence was measured. The source of this anomaly is believed to be related to the presence in the carbide of an energy gap or a semimetallic state with a weak, overlapping band and represents the energy absorbed during the transition of electrons of the valence band to mixed levels, forming 1.3×10^{19} cm^{-3} hole carriers of current. (tr-auth)

6827 CONCENTRATION DEPENDENCE OF THE THERMAL EMF OF SOLID ALLOYS OF NONTRANSITION METALS. Zelyavskii, V. B.; Khar'kov, E. I. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 9, 1567-70(Sep 1972). (In Russian).

The concentration dependence of the absolute differential thermal emf of the solid binary alloys Sn–In (100°C), In–Pb (120°C), and Al–Zn (400°C) was determined. The results are discussed in terms of the diffraction model of the metal. The experimental data agree satisfactorily with those calculated from this model. (tr-auth)

6828 PROBLEM OF THE WORK FUNCTION OF TRANSITION METALS. Okhremchuk, L. N.; Podgrushko, N. F.; Podchernyaeva, I. A.; Fomenko, V. S. (Inst. for Study of Materials Problems, Moscow). Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 1, 164-5(Jan 1972).

Translated from Radiotekh. Elektron.; 17: No. 1, 205-6(Jan 1972).

The electronic work function was measured at 300°K for carbides of transition metals, using the contact potential difference method. The carbides studied were $TiC_{0.73}$, $VC_{0.87}$, $NbC_{0.99}$, and $TaCo_{0.85}$. Results were compared with thermionic emission work functions extrapolated down to 300°K; they are in agreement, contradicting the thin-film thermionic emission hypothesis. (D.L.C.)

6829 OBSERVATION ON THE INTERPRETATION OF MAGNETOACOUSTIC GEOMETRICAL RESONANCES, WITH PARTICULAR REFERENCE TO INDIUM. Cowey, J. E.; Gerber, R.; MacKinnon, L. (Univ. of Essex, Wivenhoe Park, Eng.). Phys. Lett.; 42A: No. 2, 145-6(20 Nov 1972).

The interpretation of magnetoacoustic geometrical resonances in indium is shown to be consistent with the dominance of orbits where orbit k is stationary with respect to k in the field direction; experimental results of Rayne (Phys. Rev., 129: 652(1963)) are confirmed. (auth)

6830 SPECTROSCOPY OF RARE EARTH OXIDE SYSTEMS. II. SPECTROSCOPIC PROPERTIES OF ERBIUM OXIDE. Dean, J. R.; Bloor, D. (Queen Mary Coll., London). J. Phys., C (London); 5: No. 20, 2921-40(17 Oct 1972).

Electronic excitations of Er^{3+} ions in erbium oxide were observed by far-infrared and optical spectroscopy. Far-infrared absorptions due to ions on the two inequivalent crystallographic sites were identified by their temperature and magnetic field dependence. The g factors of levels observed in both spectral regions were used to test the C_2 site crystal-field parameters of Gruber et al. (J. Chem. Phys., 45: 477-82(1966)). The C_{3i} site parameters were deduced on the basis of this work and the published Raman spectra. These results are compared with a simultaneous fit to the low-lying levels of both sites using a superposition crystal-field model. The electronic levels were observed to shift and split with the onset of antiferromagnetic ordering at 3.4°K. Unequal shifts are attributed to a magnetostrictive expansion of the lattice in the ordered state. Comparison of the splitting of levels in external and internal fields indicates that $Er^{3+}-Er^{3+}$ exchange interactions are important. Additional absorptions occur in the far infrared which are identified as magnon sidebands of both electronic and phonon absorptions. (auth)

6831 MAGNETIC CONTRIBUTION TO THERMAL CONDUCTIVITY OF NEODYMIUM. Rao, K. V.; Aestroem, H. U.; Johannesson, Ch. (Royal Inst. of Tech., Stockholm). Phys. Lett.; 42A: No. 1, 53-5(6 Nov 1972).

An additional contribution to the thermal conductivity of neodymium below its Néel temperature at 7.5°K was observed. This is believed to be of magnetic origin. (auth)

6832 APW BAND STRUCTURE OF METALLIC VO_2. Chatterjee, S. (Univ. of Waterloo, Ont.); Mitra, T. K.; Hyland, G. J. Phys. Lett.; 42A: No. 1, 56-8(6 Nov 1972).

The band structure of rutile VO_2 is obtained fully along the ΓΔZ direction and found to be consistent with the semimetallic nature of the material. (auth)

6833 ELECTRON MICROSCOPY OF THE NIOBIUM OXIDES. I. TWINNING AND DEFECTS IN H-Nb_2O_5. Anderson, J. S.; Browne, J. M.; Hutchison, J. L. (Inorganic Chemistry Lab., Oxford). J. Solid State Chem.; 5: No. 3, 419-31(Nov 1972).

Two-dimensional direct lattice imaging was used to identify the detailed structure of faults in stoichiometric H-Nb_2O_5 crystals grown under different conditions. Material grown at 1000°C showed occasional twinning on $(10\bar{1})$; only one of two possible twin structures was identified. Material grown at lower temperatures frequently incorporated "wrong sized" blocks, equivalent to inserted lamellae of M- or N-Nb_2O_5. Heavily faulted twinned and intergrown structures are occasionally formed, and in such a regularly and recurrently twinned variant of the H-Nb_2O_5 structure was identified as a microdomain. (auth)

6834 MAGNETIC AND CRYSTALLOGRAPHIC CHARACTERISTICS OF SOLID SOLUTIONS OF Gd IN Pd AND Pd–Ag ALLOYS. Schaller, H. J.; Craig, R. S.; Wallace, W. E. (Univ. of Pittsburgh). J. Solid State Chem.; 5: No. 3, 338-41(Nov 1972).

The range of solid solubility of gadolinium in palladium was determined by x-ray analysis. The lattice parameters showed a linear increase from pure palladium to $Pd_{0.88}Gd_{0.12}$. At higher gadolinium concentrations ($0.12 < X_{Gd} < 0.25$), the existence of a two-phase region was observed, the compositions of the phases being represented by the formulas $Pd_{0.88}Gd_{0.12}$ and Pd_3Gd. Magnetic measurements indicated ferromagnetic ordering at 6°K for $Pd_{0.9}Gd_{0.1}$ and at 4°K for $Pd_{0.98}Gd_{0.02}$. From the saturation magnetization at liquid helium temperatures, the moment associated with a solute gadolinium atom was determined to be $6.5\,\mu_B$. Measurements of the susceptibility on $(Pd_{1-x}Ag_x)_{0.93}Gd_{0.07}$ alloys showed that gadolinium atoms in solid solution donate their valence electrons to the 4d and 5s band of palladium. (auth)

6835 THERMOELECTRIC AND THERMOMAGNETIC EFFECTS IN GRAPHITE. Sugihara, K.; Takezawa, T.; Tsuzuku, T.; Hishiyama, Y.; Ono, A. (Matsushita Electric Industrial Co., Ltd., Osaka). pp 543-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Anomalous thermopower without and with magnetic field in a single-crystal graphite was observed at low temperatures. Phonon drag components, calculated with the aid of the coupled Boltzmann equation for H = 0 and the transport equation in the strong-field region, explain the observed results qualitatively. In the calculations a simplified band model is employed. (auth)

6836 MAGNETOSTRICTION AND MAGNETIC BREAKDOWN IN CADMIUM. Carter, J. M.; Sparlin, D. M. (Univ. of Missouri, Rolla). pp 571-3 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The monotonic magnetostriction of cadmium was studied at 4.2°K in fields to 7.0 tesla. The angular variation of an extremal (H_m) of the magnetostrain curve is proportional to $(\cos\phi)^{-1}$. The value of H_m for H applied parallel to [0001] is in agreement with the onset of a breakdown orbit for applied field along the C axis. (auth)

6837 NUCLEAR HEAT CAPACITY AND NUCLEAR COOLING OF METALLIC PRASEODYMIUM. Gregers-Hansen, P. E.; Krusius, M.; Pickett, G. R. (Univ. of Tech., Helsinki). pp 715-16 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The nuclear heat capacity of a sample of praseodymium metal was measured from 16 mK to 500 mK in fields from 0 to 19 kOe. In zero field the heat capacity indicates that the ions on half the crystal sites have a magnetic moment of about $0.7\,\mu_B$. On applying 19 kOe the remaining sites order to about $0.7\,\mu_B$ also. The polarizability of these second sites was used to cool the specimen to 12 mK by demagnetization from 19 kOe. (auth)

6838 LOW-TEMPERATURE RESISTANCE ANOMALIES IN RHODIUM–3d AND MOLYBDENUM–3d SOLUTE ALLOYS. Coles, B. R.; Mozumder, S.; Rusby, R. (Imperial Coll. of Science and Tech., London). pp 737-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Studies of the anomalous resistance behavior of Rh–Fe alloys are extended to Rh–Cr, Rh–Mn, Rh–Co, and Rh–Ni alloys and to lower temperatures. In Rh–Fe and Rh–Mn the resistivity is still decreasing at 0.4°K and no T^2 region is found. In Rh–Co a very much smaller decrease is observed and in Rh–Cr a very weak minimum is found. Resistance minima are produced by Fe and Co in Mo but V, Cr, and Ni give no anomalies. These effects can be qualitatively understood in terms of the relative roles of local spin fluctuations and impurity scattering resonances. (auth)

6839 MAGNETIC FIELD AND TEMPERATURE DEPENDENCES OF SUSCEPTIBILITY AND RESISTIVITY IN DILUTE Rh–Fe AND Au–V ALLOYS. Sakamoto, N.; Yamaguchi, Y.; Waki, S.; Ogawa, S. (Electrotechnical Lab., Tokyo). pp 739-40 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

The susceptibility and resistivity of dilute Rh–Fe and Au–V alloys were measured as functions of magnetic field and temperature. A field-dependent H^2/T term in the magnetic field dependence of the susceptibility in the range $2\,\mu_B H < kT$ and the nonlinear concentration effects on the temperature dependences of susceptibility and resistivity were found. (auth)

6840 S–F INTERACTION IN SILVER–GADOLINIUM DILUTE ALLOYS. Nakamura, A.; Nishihara, Y.; Kinoshita, N. (Electrotechnical Lab., Tokyo). pp 743-4 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

An experimental study of Ag–Gd and Ag–Gd–Al dilute alloy system was performed. A negative component of magnetoresistance was observed. The strong effect of Al on the ESR linewidth is understood by the bottleneck effect of the conduction electron spin, although the large positive g-shift caused by Al can not be explained quantitatively. (auth)

6841 MAGNETIC ANOMALY IN THE HEAT CAPACITY OF TcF_6 AT 3.12°K. Osborne, D. W.; Schreiner, F. (Argonne National Lab., Ill.). pp 797-8 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Heat capacity measurements on technetium hexafluoride showed a lambda-shaped anomaly at 3.12°K. Between 5.8 and 22°K, discontinuous heating was used; between 2.23 and 11.35°K the warm-up rate due to the radioactivity of ^{99}Tc was measured, and the results were normalized to the heat capacities between 5.8 and 11.35°K. Magnetic susceptibility measurements indicate that the crystals are ferromagnetic below 3.12°K. (auth)

6842 SECOND-ORDER RAMAN SPECTRA AND PHONON SPECTRUM OF LiD. Jaswal, S. S.; Sharma, T. P.; Wolfram, G. (Univ. of Nebraska, Lincoln). Solid State Commun.; 11: No. 9, 1151-5(1 Nov 1972).

The second-order Raman spectra of LiD are studied at room and liquid nitrogen temperatures. These spectra are such that they can be compared with the temperature-weighted two-phonon density of states to get information on phonons throughout the first Brillouin zone. This comparison is used to supplement the neutron scattering results to formulate a very good deformation dipole model for the lattice dynamics of LiD. (auth)

6843 NEUTRON SCATTERING STUDY OF THE VIBRATIONAL AND DIFFUSIONAL MOTIONS OF DEUTERIUM IN THE α AND β PHASES OF VD. Rowe, J. M. (Argonne National Lab., IL.). Solid State Commun.; 11: No. 9, 1299-1302(1 Nov 1972).

The quasi-elastic and inelastic scattering of cold neutrons (E_0 = 5 MeV) from $VD_{0.5}$ in the α and β phases was measured. In agreement with earlier results for vanadium hydrides, the broadening due to diffusion in the β phase is too small to be measured. In the α phase, the diffusive broadening in the quasi-elastic region compared to vanadium hydride is consistent with the ratio of the square root of the masses of the two isotopes. The local-mode frequencies observed for both the α and β phases are also consistent with a square root of mass dependence, compared to earlier results for vanadium hydride. The observed similarities show that, for this concentration, the hydride and deuteride of vanadium are analogous, in spite of known differences in the phase diagrams for the two isotopes. (auth)

6844 HALL EFFECT STUDIES IN YTTERBIUM THROUGH THE f.c.c.–h.c.p. TRANSFORMATION. Alderson, J. E. A.; Hurd, C. M. (National Research Council of Canada, Ottawa). Solid State Commun.; 11: No. 9, 1245-8(1 Nov 1972).

The Hall coefficient (R_H) of polycrystalline Yb showing the fcc–hcp transformation was determined at 20 kOe in the range 1.8 to 420°K. Both the structural and the associated magnetic transformation would separately be expected to modify R_H, but the evidence suggests that the observed behavior through the transition arises primarily from the effects of the change in structure. A more detailed interpretation is presently not possible, however, because of the lack of knowledge of the band structure of hcp Yb. (auth)

6845 LUMINESCENCE OF $^5D_3$ AND $^5D_4$ LEVELS OF Tb^{3+} IN BORATE, PHOSPHATE, AND TUNGSTATE GLASSES EXCITED BY CATHODE RAYS AS A POSSIBLE TOOL FOR THE STUDY OF SURFACE FLUORESCENCE IN GLASSES. Brandstadter, I. J.; Reisfeld, R.; Larach, S. (Israel Atomic Energy Commission, Beersheba). Solid State Commun.; 11: No. 9, 1235-8(1 Nov 1972).

Borate, phosphate, and tungstate glasses doped by Gd^{3+}, Tb^{3+}, and Eu^{3+} were excited by cathode rays. As a result of this, fluorescence identical with the fluorescence of glasses excited by optical means was observed. In the Tb^{3+}-doped glasses, strong fluorescence from $^5D_3$ level was obtained. This fluorescence was not observed under optical excitation with the Tb^{3+} concentration studied. The absence of quenching of the $^5D_3$ level is discussed. It is proposed that cathode-ray excitation can be used as an instrument for studying surface fluorescence in glasses. (auth)

6846 POSITRON ANNIHILATION AS A NEW METHOD FOR STUDYING THE STRUCTURES AND PROPERTIES OF MATERIALS. Gol'danskii, V. I.; Shantarovich, V. P. (Inst. of Chemical Physics, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 4, 525-38(Apr 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 4 601-19(Apr 1972).

A review is presented of the positron method for studying electronic structure and transitions in solids and liquids. The three main mechanisms of positron annihilation (positronium formation, quasi-free collisions with electrons from atoms, and formation of bound state of positron in multielectron system) and the kind of information they yield on the properties and structure of the medium are discussed, and examples of each are given. (12 figures, 89 references) (D.L.C.)

6847 MAGNETIC PROPERTIES OF SOLID SOLUTIONS IN THE SYSTEM Sc_2O_3–V_2O_3. Bazuev, G. V.; Perelyaev, V. A.; Shveikin, G. P. (Inst. of Chemistry, Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 4, 634-6(Apr 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 4, 729-32(Apr 1972).

Measurements were made of the magnetic susceptibility of Sc_2O_3–V_2O_3 solid solutions in the range 0 to 80 mole % Sc_2O_3 and 77 to 300°K. The specific susceptibility increases with Sc_2O_3 content up to 50 mole % and then decreases linearly. The molar susceptibility of V_2O_3 decreases with V_2O_3 content due to pairing of V^{3+} cations. Solid solutions with 0 to 10 mole % Sc_2O_3 undergo a magnetic transition similar to that in V_2O_3, with a smaller susceptibility jump. For 15 to 80 mole % Sc_2O_3, the Curie–Weiss law is obeyed. (D.L.C.)

6848 CRYSTAL STRUCTURE OF THE $(Re,Co)_7B_4$ COMPOUND. Krip'yakevich, P. I.; Kuz'ma, Yu. B.; Chepiga, M. V. (Lvov State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. A: No. 9, 856-8(Sep 1972). (In Ukrainian).

The crystal structure of the ternary Re–Co–B compound, richest in boron, was determined by means of single-crystal x-ray analysis. The compound has the composition $(Re,Co)_7B_4$ (the cobalt content is 18.2 to 31.8 at. %) and the tetragonal structure with a = 5.347 to 5.265, c = 7.921 to 8.004 Å, c/a = 1.485 to 1.520; the space group is $P4/mbm-D^5_{4h}$. The atoms are in the following positions: 8 Re in 8(k) with x = 0.175; z = 0.286, 2 Re + 2 Co in 4(g) with x = 0.329; 2 Co in (b); 4 $B^{(1)}$ in 4(h) with x = 0.372; 4 $B^{(2)}$ in 4(e) with z = 0.139. The structure represents the combination of the Al_2Cu and U_3Si_2 types ($R_7X_4 = 2R_2X \cdot R_3X_2$); it forms the homologous series $R_{2\,m+3n}X_{m+2\,n}$ together with Cr_5B_3 type ($R_5X_3 = R_2X \cdot R_3X_2$). (auth)

6849 NEUTRON SCATTERING IN SOLID ^4He AT LARGE MOMENTUM TRANSFER. Sears, V. F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Solid State Commun.; 11: No. 10, 1307-10(15 Nov 1972).

Neutron inelastic scattering experiments on solid ^4He at large momentum transfer are used to determine the moments of the velocity spectrum of the crystal, $f(\omega)$. The results obtained suggest that, as a consequence of anharmonic effects, $f(\omega)$ differs significantly from the phonon-frequency spectrum and, in particular, has a long high-frequency tail. (auth)

6850 ACTINIDE PNICTIDES AND CHALCOGENIDES. 1. STUDY OF MAGNETIC ORDERING AND ORDERED MOMENTS IN URANIUM MONOCHALCOGENIDES BY NEUTRON DIFFRACTION. Wedgwood, F. A. (Atomic Energy Research Establishment, Harwell, Eng.); Kuznietz, M. J. Phys., C (London); 5: No. 21, 3012-20(31 Oct 1972).

Measurements on powdered samples of USe and UTe show that these compounds are simple ferromagnets with the moments probably directed along the rhombohedral axis as found in a single crystal of US. Compared with an ordered magnetic moment (at 4.2°K) of 1.70 ± 0.03 μ_B in US, the values 2.0 ± 0.1 μ_B and 2.2 ± 0.1 μ_B were found in USe and UTe, respectively. These values are significantly higher than the values measured by magnetization due to the large magnetic anisotropy associated with the rhombohedral distortion and also due to conduction electron polarization effects. The increase in ordered magnetic moment within the uranium monochalcogenides is thus similar to that within the uranium monopnictides. This similarity is discussed in terms of existing models of the electronic structure of these compounds. (TSS) (auth)

6851 ELECTRON STRUCTURE OF BINARY COMPOUNDS OF VANADIUM WITH NON-TRANSITION ELEMENTS. Kurmaev, E. Z.; Nemnonov, S. A.; Belash, V. P.; Efimov, Yu. V. (Inst. of the Physics of Metals, Sverdlovsk, USSR). Fiz. Metal. Metalloved.; 33: No. 3, 578-83(May 1972). (In Russian).

The compounds VB_2, V_3Al, V_5Si_3, V_5Ge_3, V_3Sn, and V_3Sb were investigated by means of x-ray emission spectroscopy, and the data were compared with those previously obtained for pure V, $VC_{0.88}$, VN, VO, V_3Si, V_3Ga, V_2Ga_5, V_3Ge. With increasing atomic number of the element combined with V, the energy separation of the spectra sub-bands increased, a phenomenon connected with a decrease in the energies of the ns and np levels of the atom of the nonmetal. (tr-auth)

6852 X RAY SPECTRA AND ENERGY BAND STRUCTURE FOR THE MONOCARBIDES OF VANADIUM, ZIRCONIUM, AND NIOBIUM. Potorocha, V. I.; Tskhai, V. A.; Gel'd, P. V., Kurmaev, E. Z. (Inst. of Chemistry, Sverdlovsk, USSR). Fiz. Metal. Metalloved.; 33: No. 3, 666-9(May 1972). (In Russian).

Histograms of total and partial densities of states and x-ray spectra were prepared for the three carbides $VC_{0.88}$, ZrC, and NbC. The energy bands and x-ray spectra are discussed in terms of quantum-mechanical considerations. (K.S.W.)

6853 NUMBER OF VALENCE SP ELECTRONS IN THE TRANSITION METALS. Bambakidis, G. (Lewis Research Center, Cleveland). Phys. Status Solidi (b); 54: No. 1, K57-60 (1 Nov 1972).

Estimates of the number of sp electrons N_{sp} are made assuming $N_{sp} \sim (E_F - E_O)^{\frac{1}{2}}$, where E_F is the Fermi level and E_O is the bottom of the sp band. $E_F - E_O$ values are obtained from existing band-structure calculations, and N_{sp} values are tabulated for the 3d, 4d, and 5d transition metals. Two trends are apparent: N_{sp} decreases for the lighter metals in each row, and N_{sp} for the 4d period is less than for the 3d and 5d periods. Comparisons are made with values inferred from soft x-ray emission spectra and line half-widths and band-theory d-band widths for the 4d metals. (D.L.C.)

6854 QUASI-ELASTIC NEUTRON SCATTERING ON HYDROGEN IN NIOBIUM SINGLE CRYSTALS. Stump, N. (Kernforschungsanlage, Juelich, Ger.); Gissler, W.; Rubin, R. Phys. Status Solidi (b); 54: No. 1, 295-302(1 Nov 1972).

Quasi-elastic neutron scattering experiments on the system $NbH_{0.07}$ were performed with niobium single crystals at T = 235 and 256°C. The width of the quasi-elastic line was measured 1) for fixed momentum transfer $|\varkappa|$, changing the angle between $\varkappa$ and a reference plane of the crystal, and 2) dependent on $|\varkappa|$, the $\varkappa$-vector parallel to three symmetry directions. The results were compared with theoretical half widths corrected for experimental resolution. They favor the tetrahedal-site model assuming simple jump diffusion. However, in the (001) direction deviation from the predicted behavior occurs and the obtained value of the mean residence time differs by a factor of two from that derived from the macroscopic diffusion constant assuming tetrahedral sites. (auth

6855 EFFECT OF TRIGONAL WARPING ON LANDAU LEVELS OF GRAPHITE. Gupta, O. P.; Wallace, P. R. (McGill Univ., Montreal). Phys. Status Solidi (b); 54: No. 1, 53-60 (1 Nov 1972).

A successive approximation scheme was devised for taking account of the trigonal warping (γ_3) terms in the calculation of the lower-lying magnetic levels of graphite at fields $\geq$ 20 kG. A two-component effective Hamiltonian was introduced for these levels. Starting from analytic expressions in the case $\gamma_3 = 0$, straightforward and simple iteration schemes were devised (i) to take account of the higher levels and (ii) to obtain the γ_3 contributions. It was found that the trigonal warping changes the levels only by a few percent except for the $n = 0$ levels. The levels $n = 0, 1, 2, 3$ were calculated for a range of fields from 20 to 200 kG. (auth)

6856 LOCALIZATION OF $4d^1$ ELECTRONS NEAR PROTONS IN MoO_3 SINGLE CRYSTALS (ESR MEASUREMENTS). Sperlich, G.; Frank, G.; Rhein, W. (Technische Hochschule, Darmstadt, Ger.). Phys. Status Solidi (b); 54: No. 1, 241-6(1 Nov 1972).

It is shown by ESR measurements on differently treated single crystals of MoO_3 that in these crystals the localisation of molybdenum $4d^1$ electrons is always connected with the presence of protons. The parameters of the transferred hyperfine interaction tensor are determined. (auth)

6857 LATTICE DYNAMICS OF CADMIUM AT 88K. Toussaint, G.; Champier, G. (CNRS, Nancy). Phys. Status Solidi (b); 54: No. 1, 165-72(1 Nov 1972).

Phonon-dispersion curves along the $[01\bar{1}0]$, $[11\bar{2}0]$, and [0001] symmetry directions of hcp metal cadmium were measured by diffuse scattering of x rays at 88°K. A general interatomic force-constant model was used to fit the phonon frequencies; interactions up to at least sixth neighbors have to be taken into account. A frequency-distribution function was calculated and used to calculate the specific heat and anisotropic Debye–Waller factor. Finally, by comparing the calculated frequency dispersion curves to the curves obtained from x-ray-scattering experiments, the parameters of a pseudopotential model were calculated. (auth)

6858 INFLUENCE OF THE NONLOCALITY OF SHAW'S MODEL POTENTIAL ON THE BAND STRUCTURE OF Be. Taut, M. (Technische Univ., Dresden). Phys. Status Solidi (b); 54: No. 1, 149-57(1 Nov 1972).

A method is given for the treatment of the energy dependence of a linear energy-dependent potential. The energy dependence of Shaw's model potential causes an increase of the band width. The density of states and the Fermi surface using the nonlocal model potential agree with experiment, whereas the local approximation is not appropriate. (auth)

6859 ATOMIC ORDERING IN THE NICKEL–IRON–TUNGSTEN SYSTEM. Iveronova, V. I.; Katsnel'son, A. A.; Silonov, V. M. (Moscow State Univ.). Fiz. Metal. Metalloved.; 33: No. 3, 535-9(Mar 1972). (In Russian).

The disposition of atoms of various kinds in alloys of $Ni_3(Fe,W)$ was experimentally investigated. The ordering of such atoms depended on the concentration of W; with 0.5 to 2.05% W antiphase, partially ordered domains of the order of 100 Å were detected. With a further increase in W concentration, a decrease in the extent of ordering occurred. In alloys with ~ 5% W ordering ceased, with only short-range order remaining. (tr-auth)

6860 ELECTROPHYSICAL PROPERTIES AND PHASE COMPOSITION OF THIN TANTALUM FILMS PRODUCED BY CATHODE SPUTTERING. Belevskii, V. P.; Belous, M. V.; Permyakov, V. G.; Yashnik, V. M. (Kiev Polytechnic Inst.). Fiz. Metal. Mettalloved.; 33: No. 3, 564-70(Mar 1972). (In Russian).

Ta films (~ 2,000 Å thick) were obtained by cathode sputtering in an Ar atmosphere at the rate of 4 to 5 Å, and were found to consist of α- and β-phases of Ta or a mixture of the two. The specific resistance of the films was 40 to 50 μohm • cm, as compared with 13.8 μohm • cm for massive Ta. The β-phase represented a new metastable modification of Ta, and (in the absence of the α-phase) had a resistance of 170 to 200 μohm • cm. The phase conversion $\beta \rightarrow \alpha$ occurred at 700 to 750°C in a vacuum. (K.S.W.)

6861 DIFFUSION OF CARBON IN ZIRCONIUM NITRIDE. Khromov, Yu. F.; Yanchur, V. P.; Eremeev, V. S. Fiz. Metal. Mettalloved.; 33: No. 3, 642-4(May 1972). (In Russian).

Diffusion of ^{14}C into $ZrN_{0.95}$ was studied at 2,030 to 2,690°C, the measured diffusion coefficients ranging from 3×10^{12} to 2.7×10^{-10}, respectively. (K.S.W.)

6862 ATOMIC ORDERING IN THE TERNARY SYSTEM Ni–Fe–V. Goman'kov, V. I.; Puzei, I. M.; Kozis, E. V.; Mal'tsev, E. I.; Sigaev, V. N. (Inst. of Precision Alloys, Moscow). Fiz. Metal. Metalloved.; 33: No. 3, 648-51(May 1972). (In Russian).

Alloys found in the section Ni_3Fe–Ni_3V of the Ni–Fe–V ternary diagram were investigated with dual diffractometers, and parameters of long-range ordering in this quasi-binary system were determined. The introduction of V up to 10 at.% causes a decrease in the superstructure of Ni_3Fe, as a result of withdrawal of Ni into the second coordination sphere around the V atoms. With continued addition of V (up to 25%), an increase in long-range ordering was observed. (K.S.W.)

6863 FERMI-SURFACE PROPERTIES OF METALS. Visscher, P. B.; Falicov, L. M. (Univ. of California, Berkeley). Phys. Status Solidi (b); 54: No. 1, 9-51(1 Nov 1972).

A review is given of the theoretical and experimental knowledge of the electronic properties of pure metals. After a consideration of the independent-particle model (Fermi–Dirac statistics and free electron gas), the following electronic properties are discussed: electronic specific heat, electron spin (Pauli) paramagnetism, dynamics in electric and magnetic fields, Landau diamagnetism, de Haas–van Alphen effect, electric and thermal conductivity, scattering mechanisms, anomalous skin effect, Hall effect, galvanomagnetic effects, cyclotron resonance, and size effects. A comprehensive table of references is presented, referring to band structure calculations, de Haas–van Alphen effect, anomalous skin effect, galvanomagnetic effects, cyclotron resonance and size effects and ultrasonics for each metal. (566 references) (D.L.C.)

Moessbauer Effects and NMR

Refer also to abstracts 6282, 6311, and 6532.

6864 HYPERFINE INTERACTIONS OF ^{220}Rn AND ^{224}Ra IMPLANTED INTO Fe, Al, Cd, AND Bi METALS. Abildskov, F.; Ansaldo, E. J.; Deutch, B. I.; (and others) (Univ. of Aarhus, Denmark). Nucl. Phys.; A194: No. 2, 292-304(1972).

The interactions on radon and radium nuclei implanted into metals were studied by means of $\alpha-\gamma$ angular correlations. The influence of source preparation and of surface oxide layers has been studied in sources prepared by evaporation and isotope separator implantation. The interactions in iron are found to have contributions from static magnetic fields as well as static quadrupole interactions. The magnetic fields for radon and radium in iron were determined to be $+920 \pm 85$ kOe and $-380 \pm$ kOe, respectively. The theoretical models used to describe the perturbations due to mixed interactions and their importance in internal field determinations are discussed. (auth)

6865 STUDY OF RADIOACTIVE IMPURITIES IN SOLIDS. II. EFFECTS OF RELAXATION AND RADIOFREQUENCY. Spanjaard, D.; Hartmann-Boutron, F. (Paris Univ., Orsay, France). J. Phys. (Paris); 33: No. 5, 565-77(May 1972).

The nuclear radiation characteristics of a radioactive impurity embedded in a solid matrix depend upon the properties of the levels involved in the radiative processes. The evolution of these levels is affected by relaxation phenomena and the radiofrequency field. Results are applied to perturbed angular correlation and nuclear orientation measurements (calculation of perturbation factors and the effect of radiofrequency saturation in experiments combining nuclear magnetic resonance and nuclear orientation techniques). (France)

6866 ELECTRON PARAMAGNETIC RESONANCE OF $^{249}Bk^{4+}$ IN ThO_2 SINGLE CRYSTALS. Boatner, L. A. (Advanced Tech. Center, Inc., Dallas); Reynolds, R. W.; Finch, C. B.; Abraham, M. M. Phys. Lett.; 42A: No. 1, 93-4(6 Nov 1972).

The EPR spectrum of Bk^{4+} was obtained for the first time. For a ThO_2 host, a Γ_6 doublet lies lowest. The nuclear spin of ^{249}Bk is confirmed as $^7/_2$ and the estimated nuclear moment is 2.2 μ_N. (auth)

6867 HYPERFINE MAGNETIC FIELDS IN CUBIC URANIUM COMPOUNDS FROM ^{238}U MOESSBAUER SPECTROSCOPY. Shenoy, G. K.; Kuznietz, M.; Dunlap, B. D.; Kalvius, B. M. (Argonne National Lab., IL). Phys. Lett.; 42A: No. 1, 61-2(6 Nov 1972).

The hyperfine fields at the uranium nucleus in magnetically ordered US and UP were found to be (3300 ± 300) kOe and (3600 ± 300) kOe, respectively. Combining this with earlier data on UO_2 and USb, and with known values of the magnetic moment on the uranium ion, it is found that J-mixing is not dominant in these cubic uranium compounds. (auth)

6868 PERTURBATION OF $\gamma-\gamma$ ANGULAR CORRELATIONS BY COHERENT ACOUSTIC VIBRATIONS. Kopvillem, U. H.; Shakhmuratova, I. N. (Physical-Technical Inst., Kazan). Phys. Lett.; 42A: No. 1, 63-4(6 Nov 1972).

The possibility of detection of acoustic vibrations by means of $\gamma-\gamma$ angular correlations is theoretically shown. A definite geometry of experiment is considered. The functions of "phonon-perturbed" $\gamma-\gamma$ angular correlations are constructed. (auth)

6869 HUGE MAGNETOCRYSTALLINE ANISOTROPY IN CUBIC RARE EARTH–Fe_2 COMPOUNDS. Clark, A. E. (Naval Ordnance Lab., White Oak, MD); Belson, H. S.; Tamagawa, N. Phys. Lett.; 42A: No. 2, 160-2(20 Nov 1972).

Magnetization and magnetic anisotropy measurements were made on single crystals of $ErFe_2$ from 77°K to room temperature. The magnetic anisotropy is much larger than any previously reported for cubic metals. Based upon these measurements, the magnetic anisotropies of the Laves-phase RFe_2 compounds (R = Tb, Dy, Ho, and Tm) were predicted. (auth)

6870 ^{51}V NUCLEAR MAGNETIC RELAXATION IN DILUTE Au–V ALLOYS AT TEMPERATURES 1 TO 300 K. Kazama, S.; Kume, K.; Mizuno, K.; Mizoguchi, K. (Tokyo Metropolitan Univ., Fukazawa, Japan). Phys. Lett.; 42A: No. 2, 141-2(20 Nov 1972).

Nuclear magnetic relaxation times T_1 and T_2 are measured in dilute Au–V alloys at 1 to 300°K. A value for $T_1T = 17.0 \pm 0.5$ msK is obtained. (auth)

6871 NUCLEAR SPIN RELAXATION OF ^{163}Dy IN FERROMAGNETIC Dy METAL AT LOW TEMPERATURE. Itoh, J.; Sano, N. (Osaka Univ.). pp 785-6 of Proceedings of the Twelfth International Conference on Low Temperature Physics. /Kanda, E. (ed.). Tokyo; Keigaku Publishing Co., Ltd. (1971).

From 12th international conference on low temperature physics; Kyoto, Japan (4 Sep 1970). See CONF-700921.

Nuclear magnetic relaxation of ^{163}Dy in ferromagnetic Dy metal was measured at liquid-helium temperatures. It is concluded that a process in which the nuclear spin energy relaxes to the kinetic energy of conduction electrons via spin waves is predominant in the spin–lattice relaxation, and the spin–spin relaxation time is solely determined by the spin–lattice relaxation. (auth)

6872 NUCLEAR MAGNETIC RESONANCE OF ^9Be IN $(Mn_{1-x}Fe_x)Be_2$ ALLOYS. Domngang, S. (Lab. Pierre Weiss, Strasbourg). Phys. Status Solidi (b); 54: No. 1, 303-9(1 Nov 1972).

The nuclear spin–lattice (T_1) and spin–spin (T_2) relaxation times of ^9Be nuclei were studied by means of spin-echo techniques in $(Mn_{1-x}Fe_x)Be_2$ alloys. T_1T is a function of temperature and composition. The spin–spin relaxation processes as measured by the decay of the spin echo envolope exhibit Gaussian time dependences. The relaxation rate $1/T_2$ is found to increase when the temperature decreases. The Knight shift of ^9Be is negative and is a function of temperature and composition of the alloys. An interaction A I⟨S⟩ between nuclear spin (^9Be) and impurity spin (iron) allows to explain the behavior of the relaxation rate and Knight shift of ^9Be for $x \leqq 0.16$. (auth)

Theory

Refer also to abstracts 6597 and 6598.

6873 (COO–2204-1) ACOUSTIC EMISSION AND THE PORTEVIN-LE CHATELIER EFFECT. Progress Report, March 1, 1972–November 1, 1972. Hartman, W. F. (Johns Hopkins Univ., Baltimore, Md.). 1972. Contract AT(11-1)-2204. 6p. Dep. NTIS.

6874 EFFECTIVE ELECTRON–POSITRON INTERACTION IN METALS. De Freitas, L. G.; Lobo, R. (Escola de Engenharia, Sao Carlos, Brazil). Phys. Lett.; 42A: No. 1, 83-4(6 Nov 1972).

A new electron–positron effective potential is obtained by means of canonical transformations. The screening function is similar to the electron–test charge dielectric function. (auth)

PHYSICS (THEORETICAL)

Refer also to abstracts 5988, 6097, 6202, 6210, 6242, 6605, and 6882.

6875 (CNRS-CPT-72-P-456) SCHROEDINGER OPERATORS WITH SYMMETRIES. Balslev, E. (Centre National de la Recherche Scientifique, Marseilles (France). Centre de Physique Theorique). Apr 1972. 92p. Dep. NTIS (U. S. Sales Only).

The stationary Schroedinger operator H of a many-body system with two-body rotational invariant interactions is considered. The operator H is reduced with respect to the symmetries of permutation of identical particles, rotations and reflections, into a direct sum of operators $H_{\text{tau bar}}$ where tau bar is an index of the irreducible representations of the symmetry group of the system. The spectral theory of these operators, developed on the basis of the Weinberg equations, is completed and simplified. The case of a system that can be decomposed into two identical subsystems is studied in detail. (France)

6876 (JUL-845-MA) SYSTEMATIC TESTS OF THE ASSUMED CONTINUOUS DISTRIBUTION LAW FOR USE IN MONTE-CARLO METHODS. Schluesener, H. (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Angewandte Mathematik). Apr 1972. 23p. (In German). Dep. NTIS (U. S. Sales Only).

The question of how one, in set test magnitudes n, can generally produce a systematic test so that it is adapted as well as possible to the assumed distribution law is examined. It is assumed that the basic totality of characteristic values x satisfy a continuous distribution. The distribution function of the probability magnitude x is represented by $F(X) = \int_{-\infty}^{x} f(t)dt$, where the real function f(x) is nonnegative. The continuity of this density f(x) is assumed and it follows that the distribution function is continuously differentiable and has the derivation f(x). (tr-auth)

6877 (LA-5061) MONTE CARLO SAMPLER. Everett, C. J.; Cashwell, E. D. (Los Alamos Scientific Lab., N. Mex.). Oct 1972. Contract W-7405-eng-36. 47p. Dep. NTIS.

Methods are given for sampling the standard probability densities arising in physical, chemical, and statistical problems, by means of machine generated "random numbers." The probability theory underlying each device is briefly indicated. The collection is intended as a reference work for Monte Carlo practice. (auth)

6878 CLASSICAL EXPRESSION OF CONSERVATION LAWS OF GENERALIZED MOMENTA IN QUANTUM MECHANICS. Su, D. R. (National Taiwan Univ., Taipei). Chin. J. Phys. (Taiwan); 10: No. 1, 49-52(Apr 1972).

In a previous paper, an equation is written down for $S \equiv e^{-iW/\hbar}\phi$ instead of the energy eigenfunction ϕ, with W being the classical Jacobi W function solved from the classical Hamilton-Jacobi equation. Coulomb interaction is illustrated as an application of this equation and the independence of S on certain generalized coordinate q is interpreted as the equality (conservation law) of its canonical conjugate momentum p both in the classical system described by W and in the quantum system described by ϕ. The explicit dependence on q of ϕ can be, thus, easily obtained from W, a classical function. (auth)

6879 SOLUTION OF THE TIME DEPENDENT SCHROEDINGER EQUATION USING LAPLACE TRANSFORMATION METHOD. Hladik, Jean. Compt. Rend.; Ser. B; 275: No. 4, 177-8(24 Jul 1972). (In French).

The time-dependent Schroedinger equation is solved using Laplace transformation and a time-dependent Hamiltonian. (France)

6880 EQUIDISTANCE OF ENERGY LEVELS OF A ONE-DIMENSIONAL SCHROEDINGER EQUATION. Krivchenkov, V. D.; Kukin, V. D. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 204: No. 1, 60-2(1 Mar 1972). (In Russian).

The energy levels of a harmonic oscillator are equidistant. The class of potentials, other than those of a harmonic oscillator, and for which a one-dimensional Schroedinger equation possesses equidistant energy spectra, was investigated. (K.S.W.)

6881 MACROSCOPIC LEVEL OF QUANTUM MECHANICS. George, C. (Univ., Brussels); Prigogine, I.; Rosenfeld, L. Nature (London); 240: No. 5375, 25-7(3 Nov 1972).

The problem of relating the quantum mechanical description of atomic processes to the behavior of matter in bulk is resolved in a conceptually simple treatment. (auth)

6882 QUANTUM METROLOGY: STANDARDS OF MEASUREMENT BASED ON ATOMIC AND QUANTUM PHENOMENA. Cook, A. H. (Univ. of Edinburgh). Rep. Progr. Phys.; 35: No. 5, 463-528(1972).

A review is presented of the development of standards of measurement based on atomic and quantum phenomena. The past quarter of a century has seen a great change in ideas about units and standards of measurement. The system based on mechanical standards such as the meter bar is being replaced by one based on atomic and quantum phenomena such as a wavelength of light. The new system is now, in part, internationally accepted through definitions of the meter based on a wavelength of light of krypton and of the second based on a hyperfine transition in cesium. The advantages of the new system are in part conceptual, but principally they are practical since the new standards are more generally available and allow more accurate and more convenient measurements in science and engineering. Emphasis is placed in this review on the importance of precise measurements in gaining new knowledge of the physical world and in applying it in engineering, and it is argued that the most important property of a system of measurement is that it should be widely and easily available. The physical principles of atomic standards of frequency and length are explained, the ways in which they are realized at present are described and the possibility of a unified system of units of length and time based on frequency is discussed. The present basis of the electrical units is explained and an account is given of work in progress whereby it may be replaced by a system related to frequency through such phenomena as the Josephson effect between superconductors and the precession of protons in a magnetic field. The relation of the fundamental constants of physics to metrology is discussed, examples of current work on their determination being given. Finally, the possible structure of a system of units and standards based on frequency is considered and some examples of modern demands on metrology are given. (auth)

6883 ELEMENTARY QUANTUM MECHANICS. Mott, N. F. London: Wykeham Publications (1972). 122p.

The subject is dealt with in sections: quantization of energy; properties of radiation (the harmonic oscillator, the light quantum or photon); the old quantum theory (x-ray spectra); the wave properties of matter; standing waves and the quantization of energy (the complex form of the wave function, normalization of the wave function); the Schrödinger equation (some problems involving potential steps, the method of Wentzel, Kramers and Brillouin, the application of the method of Wentzel, Kramers, and Brillouin to alpha decay, the Schrödinger equation in three dimensions); calculation of quantized energies (an electron moving on a straight line between two fixed points, an electron moving between two grids, the harmonic oscillator, quantization in two or three dimensions, particles in a circular or spherical box); the Schrödinger equation for an electron in an atom (atoms of elements in the first column of the periodic table (the alkali metals), the electron spin); the many-electron atom (x-ray spectra,quantum-mechanical explanation of the exclusion principle); molecules and solids (the chemical bond, the water molecule, electrons in solids, an unsolved problem); quantum mechanics and the uncertainty principle; absorption of radiation. (UK)

6884 NEW SPINOR CALCULUS. Rastall, P. (Univ. of British Columbia, Vancouver). Gen. Relativity Gravitation; 3: No. 3, 281-304(Oct 1972).

Spinor calculus is developed in a simple, axiomatic manner, without the use of fiber bundles. Tangent vectors of space-time are identified with self-adjoint endomorphisms of spin spaces. Only one spin space is defined at each point, instead of the two which are required in traditional spinor calculus. The properties of the spin connection and spin curvature are derived. The spinor index formalism and the formalism of complex 3-vectors are discussed. (auth)

6885 FREDHOLM DETERMINANT AND JOST FUNCTION IN SCATTERING THEORY. Nesbet, R. K. Comments At. Mol. Phys.; 3: No. 5, 143-52(Sep 1972).

Applications of the integral equation theory of Fredholm to electron-atom scattering have recently been explored by Reinhardt (Phys. Rev., A1: 1162(1970); loc. cit. A2: 1767 (1970); loc cit. A4: 429 (1971); loc. cit. A5: 757 (1972); J. Phys. B.4: 1279 (1971); Chem. Phys. Lett. 11: 562 (1971); Phys. Rev. Lett. 28: 401 (1972)), who has shown that the theory leads to very satisfactory computational procedures. The information, however, involves elements that may appear rather "mysterious" to those familiar only with standard computational methods in this field, and the purpose of this communication is to point out some relations between the Fredholm method and standard com-

putational procedures. These relations indicate that aspects of the Fredholm method can be employed in the contrast of standard methods, and in two cases of general interest procedures that arise naturally are found to be equivalent to methods recently put forward as significant advances in standard computational techniques. The basic definitions of the Fredholm method (Jost function and Fredholm determinant) are given, followed by a discussion of multichannel potential scattering, and the Kohn variational method for many-electron multichannel scattering. (11 references) (UK)

6886 VARIATIONAL METHOD IN STATISTICAL MECHANICS. Phythian, R. (University Coll., Swansea, Eng.). J. Phys., A (London); 5: No. 11, 1566-72(Nov 1972).

A variational method, similar to the Frenkel variational method of quantum mechanics, is derived for the time development of phase functions of a system. It is shown how this method may be used to obtain approximations for quantities of interest such as the density autocorrelation function of a fluid in equilibrium. (auth)

REACTOR TECHNOLOGY

Power Reactor Development

6887 (KFK-EXT-8/72-2) FIRST REGENT SEMIANNUAL REPORT, OCTOBER 1971–MARCH 1972. Enderle, G.; Katz, F.; Leinemann, K.; Schlechtendahl, E. G.; Schnauder, H.; Schumann, U.; Schuster, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jun 1972. 34p. (In German). Dep. NTIS (U. S. Sales Only).

The project REGENT (German acronym for CAD, computer aided design) was undertaken by the Institut fuer Reaktorentwicklung as an internal project and started early 1972. During the last months of 1971 some work of preparatory nature was carried out. Hence, the first semi-annual project report on REGENT includes this time period. The background of the project, its goals, the activities and the results achieved up to March 31, 1972 are described briefly. The expected advances in the next half year period are summarized. 30 references. (auth)

6888 (ORNL–4782) MOLTEN-SALT REACTOR PROGRAM. Semiannual Progress Report for Period Ending February 29, 1972. (Oak Ridge National Lab., Tenn.). Oct 1972. Contract W-7405-eng-26. 245p. Dep. NTIS.

Research and development progress is summarized in four parts. A separate abstract was prepared for each part. (D.H.M.)

For abstracts of individual sections see: 5013, 5164, 5614, and 6889.

6889 (ORNL–4782, pp 1-43) MSBR DESIGN AND DEVELOPMENT. Oct 1972.

In Molten-Salt Reactor Program.

The design study of the 300-MW(e) demonstration reactor plant was completed. The internal structure of the reactor was developed in considerable detail. Special attention was given to methods for fabrication and assembly of the different graphite pieces. Hydraulic conditions in the reactor were analyzed and temperatures of graphite were calculated. A new analysis of some earlier experiments on the stripping of iodine from LiF–BeF_2 melts has shown that, if one includes the diffusion of I^- in the melt to the gas-liquid interface as a rate limiting step, there results a mathematical model which is in accord with the experimental data, permitting an estimate of what it would take to continually remove iodine from the MSBR fuel by side-stream processing. Design studies on the MSBR core were continued, with emphasis on the design of a slab-type graphite element. Layout studies of the core include provisions for four cruciform-shaped control rods. (auth)

6890 BWR REACTORS IN GERMAN FEDERAL REPUBLIC. Kornbichler, Heinz (AEG Telefunken, Frankfurt am Main). Energ. Nucl. (Paris); 14: No. 3, 190-9(1972). (In French).

The development of nuclear energy in the Federal Republic of Germany since 1955 has occurred in several phases. The first phase involved the study of numerous types of reactor and the construction of two small power plants (15MW(e) each). This phase was followed by a period during which emphasis was laid on light-water reactors, the first large demonstration plants having capacities of between 250 and 300 MW(e) being constructed. In the third phase, which involved a transition to 600 MW(e) units it was demonstrated that nuclear power plants could operate economically. The fourth phase, which began in 1969, is characterized by the construction of a large number of economically viable nuclear plants having capacities between 800 and 1300 MW(e).

6891 NUCLEAR POWER PLANT COMPONENTS. Dorner, H. (Siemens AG, Erlanger, Ger.); Kraemer, W.; Ullrich, W. Energ. Nucl. (Paris); 14: No. 3, 200-17(1972). (In French).

The technology of the most interesting components of PWR and BWR plants is presented. The size criteria, construction, characteristics, materials, manufacturing details, and control methods are exposed in detail. A brief account of the operating experience and development trends is given. (France)

6892 TECHNICAL PROBLEMS OF A MULTI-PURPOSE LIGHT WATER REACTOR. SYSTEM DESIGN OF MULTI-PURPOSE NUCLEAR PLANT. Tamura, T. (Japan Atomic Energy Research Inst., Tokai). Genshiryoku Kogyo; 18: No. 4, 18-22(Apr 1972). (In Japanese).

Problems of multi-purpose nuclear plants, which combine light water reactors with desalting plants or petro chemical plants, are investigated. The following matters are assumed; the nuclear reactors supply steam for the desalting plants and chemical plants, and remainder steam generates electric power. But starting steam and fixed load steam for the chemical plants are supplied by other boilers. In the system of power generation and desalting plants, three combinations are considered. If large capacity system is assumed, the combination of back pressure-condensing double shaft turbines with the desalting plants is most adequate. The model systems are illustrated for this combination type with a pressurized water reactor or a boiling water reactor respectively. Moreover models for the combination of power generation with a chemical plant involving a desalting facility are introduced. Most hazardous problem of the combination plants is radiation leakage from heat exchangers. Therefore the heat exchangers must be equipped with radiation detection systems. However, under present conditions, continuous monitoring of low energy radiation cannot be performed. In order to show quantitatively improvement of efficiency in the utilization of thermal energy generated with the multi-purpose LWRs, more concrete system models must be designed and investigated. It is desirable that a low energy detection system be developed. (Japan)

6893 GAS COOLED BREEDER. Olds, F. C. Power Eng.; 76: No. 10, 44-7(Oct 1972).

Advances in gas-cooled fast reactor technology in the past decade are reviewed, and arguments are presented for building a demonstration unit. The essential question remains as to whether the electric power industry wants a second type of breeder enough to press for it and fund it. (auth)

6894 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY 1972 WINTER MEETING, WASHINGTON, D. C., NOVEMBER 12–17, 1972. Farmakes, Ruth (ed.). Trans. Amer. Nucl. Soc.; 15: No. 2, 585-992(Nov 1972). (CONF-721109).

Included are 422 brief summaries of papers on various aspects and recent developments of nuclear science and technology. Each summary is listed separately in NSA. (J.M.J.)

For abstracts of individual papers see: 4932–4937, 4977, 5105, 5156, 5157, 5167, 5176–5184, 5187, 5190–5192, 5196–5198, 5204–5212, 5217, 5219, 5245–5249, 5272, 5296, 5301, 5302, 5318–5324, 5333, 5334, 5346–5348, 5363, 5377, 5401–5404, 5410, 5411, 5416–5430, 5436–5440, 5500, 5557, 5600–5608, 5628, 5676–5679, 5680–5688, 5707–5718, 5730, 5731, 5734–5754, 5761–5765, 5771–5778, 5786, 5787, 5825, 5826, 5984, 6128, 6180–6182, 6411–6419, 6474, 6488, 6526, 6534, 6544–6548, 6616–6619, 6693, 6694, 6727–6734, 6780–6785, 6806, 6895, 6898–6914, 6917, 6926–6931, 6937–6957, 6959, 6960, 6962, 6963, 6969–6987, 6991–6996, 6999–7016, 7050–7069, 7124–7139, 7143–7150, 7155–7199, 7201–7205, and 7209–7236.

6895 FAST BREEDER REACTOR: ITS PROMISE AND ITS PROBLEMS. Benedict, M. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 15: No. 2, 586-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Physics and Core Engineering

6896 (EURFNR–1034) FAST REACTOR PROGRAMME. Second Quarter 1972 Progress Report. Hoekstra, E. K. (comp.) (Reactor Centrum Nederland, Petten). Aug 1972. 70p. (RCN–173). Dep. NTIS (U. S. Sales Only).

Work performed under United States–Euratom Fast Reactor Exchange Program.

The RCN program comprising reactor physics, fuel irradiations, advanced fuels, radiation damage in canning materials, analysis of impurities in sodium, aerosol research, heat transfer, and hydraulics is reviewed. (auth)

6897 (KFK-1624) MEASUREMENT OF γ HEATING IN THE MATERIAL OF CONSTRUCTION OF FAST CRITICAL ARRANGEMENT WITH RADIOPHOTOLUMINESCENT GLASSES. Doerfel, H. R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Jun 1972. 62p. (In German). Dep. NTIS (U. S. Sales Only).

Radiophotoluminescence glasses were used for the determination of the γ-heating in the structural materials of fast reactors. For this application an investigation of the absorption behavior of the glasses in mixed radiation fields was necessary. It was shown, that with regard to the γ-absorption the glasses are very similar to steel. So the γ-effect in the glass is nearly proportional to the γ-heating in steel. The neutron effect, amounting up to 50% of the total effect in reactors, can be corrected by means of fission rates. Measurements were performed in different fast critical assemblies. The results were in good agreement with calculations and ionization chamber measurements. (GF)

6898 COMPARISON OF THE QUASISTATIC AND DIRECT METHODS FOR TWO-DIMENSIONAL THERMAL REACTOR DYNAMICS. Dodds, H. L. Jr.; Stewart II, J. W.; Bailey, C. E. (Savannah River Lab., Aiken, S. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 786-7(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6899 ON-LINE COMPUTER METHOD FOR NEUTRON FLUX DISTRIBUTION CONTROL. Grumbach, R. (Institutt for Atomenergi, Halden, Norway). Trans. Amer. Nucl. Soc.; 15: No. 2, 791-2(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6900 GAS-COOLED FAST REACTOR DESIGN STUDIES IN THE FRG. Goetzmann, C. A.; Hassmann, K.; Rau, P. (Siemens AG, Erlangen, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 2, 845-6(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6901 ANALOGY BETWEEN THERMAL DIFFUSION AND CONTINUOUS SLOWING DOWN OF NEUTRONS AND ITS APPLICATIONS. Kalimullah (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 15: No. 2, 915-16(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6902 CRITICALITY STUDIES OF A BWR CORE VARYING HYDROGEN-TO-METAL RATIO AT DIFFERENT CORE TEMPERATURE AND VOID CONDITIONS. Khan, A. M. (Federal Univ., Rio de Janeiro). Trans. Amer. Nucl. Soc.; 15: No. 2, 916-17(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6903 PROGRESS IN FAST REACTOR PHYSICS IN THE FEDERAL REPUBLIC OF GERMANY. Kuesters, H. (Kernforschungszentrum, Karlsruhe, Ger.); Helm, F.; Henssen, H. Trans. Amer. Nucl. Soc.; 15: No. 2, 918-19(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6904 FAST REACTOR PHYSICS IN FRANCE. Bussac, J. (CEN de Saclay, Gif-sur-Yvette, France); Estavoyer, M. Trans. Amer. Nucl. Soc.; 15: No. 2, 920(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6905 CURRENT STATUS OF THE FAST REACTOR PHYSICS PROGRAM IN JAPAN. Oyama, A.; Higashihara, Y. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Trans. Amer. Nucl. Soc.; 15: No. 2, 920-1(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6906 FAST REACTOR PHYSICS IN THE USA. Avery, R. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 921(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6907 IMPROVED REACTIVITY TABLE MODEL FOR LMFBR DYNAMICS. Stacey, W. M. Jr. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 922(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6908 FLOW OSCILLATION EXPERIMENTS IN SEFOR. Lu, Y. S. (General Electric Co., Sunnyvale, Calif.); Noble, L. D. Trans. Amer. Nucl. Soc.; 15: No. 2, 923-4(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6909 TEMPERATURE DEPENDENCE OF k_∞ FOR A ThO_2–PuO_2 HTGR LATTICE. Newman, D. F. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 927-8 (Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6910 PERFORMANCE CHARACTERISTICS FOR OPTIMIZED CORE MODULE OF LMFBR. Minakuchi, S. (Iowa State Univ., Ames). Trans. Amer. Nucl. Soc.; 15: No. 2, 932-3 (Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6911 CALCULATIONS FOR FISSION PRODUCT POISONING IN FAST REACTORS. Berk, S. E.; Maynard, C. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 15: No. 2, 938(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6912 NEUTRONICS CHARACTERISTICS OF FFTF CORE USING CLEAN AND LWR-GRADE Pu FUEL. Calamai, G. J. (Westinghouse Advanced Reactors Div., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 2, 952-3(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6913 RELIABILITY ASSESSMENT OF CNEN NEUTRONIC CODES FOR Pu RECYCLING IN PWRS. Orestano, F. V.; Pistella, F. (CNEN, Casaccia, Italy). Trans. Amer. Nucl. Soc.; 15: No. 2, 953-4(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6914 CHARACTERISTICS AND PERFORMANCE OF THE 3-D LWR SIMULATOR PRESTO. Boerresen, Sigurd (Institutt for Atomenergi, Kjeller, Norway). Trans. Amer. Nucl. Soc.; 15: No. 2, 956-7(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Control Elements, Systems, and Instrumentation

6915 SHOCK ABSORPTION. Rodwell, Chritopher (to English Electric Co. Ltd.). British Patent 1,284,396. 9 Aug 1972. Filed 19 Sep 1968.
Reference is made to shock absorbers for absorbing mechanical loads. Applications include nuclear reactor control rods, locating means for reactor motor circulator units, etc. The basis of the system described is the discovery that a mass of sintered metallic material, having suitable characteristics, may be satisfactorily used as a shock absorber element when fitted to a body and deformed by a compressive force on impact occurrence. Such elements are believed to possess the distinct advantage of ability to absorb very high energies with only relatively small deformation. The shock absorbing element is composed of porous metallic material in the form of either a sintered mass of powder or a sintered mesh structure in which a number of layers of mesh are sintered together. A suitable material is sintered austenitic stainless steel, though other metals or alloys may be used, provided they are in truly sintered form, with the actual metal welded together, and are not oxide welded. The shock absorber material should contain 15 to 20% voids, and the solid should have a ductility of 10 to 20% elongation. (UK)

6916 CONTROL SYSTEMS OF MULTI-PURPOSE NUCLEAR PLANT. TECHNICAL PROBLEMS OF MULTI-PURPOSE LIGHT WATER REACTOR. Ito, A. (Kyushu Electric Power Co. Inc., Fukuoka). Genshiryoku Kogyo; 18: No. 4, 23-8(Apr 1972). (In Japanese).
The control system for multi-purpose nuclear plants with pressurized water reactors is different from that with boiling water reactors. In a desalination plant using a pressurized water reactor, the electric power generated is controlled by a governor. Even if the main steam flow fluctuates, the power of the back pressure turbine and the quantity of the fresh water produced scarcely fluctuate. When boiling water reactors are used, the electric power generated is controlled by a recirculating pump operated by velocity relays of turbines. In a dual-purpose industrial model with a pressurized water reactor, the power control is same as that in the desalination plant. A condensing turbine not only generates electric power, but also supplies steam at 15 kg/cm^2 to other plants, and a back pressure turbine also emits steam at 5 kg/cm^2. When a boiling water reactor is used, the condensing turbine only generates electric power while a back pressure turbine supplies steam for various processing. Under emergency conditions, the following matters are considered: tripping of nuclear reactors, turbines, power transmission, desalination plants, process steam, etc. Explanations are given as to whether operation can be continued or must be stopped under emergency conditions. (Japan)

6917 BOILING DETECTION IN THE 20- TO 50-kHz FREQUENCY RANGE. Dunn, M. J.; Ohanian, M. J. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 15: No. 2, 872-3 (Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Cooling Systems

6918 (CEA-CONF-2046) HYDRAULIC PROBLEMS IN SODIUM HEAT EXCHANGERS AND THEIR THERMAL EFFECTS. Kayser, G. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires); Boulot, F. (Electricite de France, Chatou). 1972. 6p. (In French). (CONF-720648–8). Dep. NTIS (U. S. Sales Only).

From 12th meeting on hydraulics; Paris, France (6 Jun 1972).

In sodium heat exchanger design, hydraulic problems mainly arise in the local areas comprising the tube cluster inlet and outlet on the casing side. Tests and calculations were carried out to determine head losses and flow patterns in these areas and to study their effect on heat exchanger thermal efficiency and stresses. (France)

6919 (EUR-4883) MODEL FOR THE THERMOHYDRODYNAMICS OF A BOILING WATER REACTOR WITH OPEN CHANNELS. Carenza, L. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Oct 1972. 32p. (In Italian). Dep. NTIS (U. S. Sales Only).

A physical model for the thermohydrodynamics of the boiling cooling channels of a nuclear reactor and its numerical reduction to finite difference form are described. The model takes into account the subcooled boiling and the detailed exchange of liquid and vapor among different subchannels in the simple assumption of open channels, i.e., considering that the pressure drops across a transversal section of the channel are negligible. (EURATOM)

6920 SEALING SYSTEM FOR REACTOR COOLANT CIRCULATOR. Koga, T. (Nippon Sealol Co. Ltd., Tokyo). Genshiryoku Kogyo; 18: No. 6, 46-51(Jun 1972). (In Japanese).

The structure, mechanism, problems and examples of axial seals for reactor coolant circulators are explained. Types of the seals are broadly classified by the types of reactors — BWR, PWR, HWR, GCR and LMFBR. It is made clear that the types of circulators and axial seals depend strongly on the characteristic features of specific reactor types. The problems encountered in making the seals are also discussed. Considering the LMFBR , pumps and their sealing systems being employed for JOYO and MONJU — Japanese experimental and prototype FBR, respectively — are explained in detail. (Japan)

6921 DEVELOPMENT OF MECHANICAL-TYPE SODIUM PUMPS. Taka, Shusei (Ebara Mfg. Co. Ltd., Tokyo). Ehara Jiho; No. 79, 20-6(Mar 1972). (In Japanese).

The test manufacture of bearings and shaft sealing parts was conducted for the development of the mechanical type sodium pump for fast breeder reactor and the pump tested with water and sodium. The pump made for test is a vertical shaft free surface type with a check valve incorporated. For the lower bearing, a hydrostatic bearing, and for the shaft sealing section a mechanical face seal were selected respectively. The pump had the capacity of cubic meter per minute with total head of 48 meters. After conducting various tests at the sodium temperature of from 300 to 550℃ including performance test, start and stop, abrupt stop (for power failure), continuous operating of tee pump, and the measurement of temperature distribution, overhauling inspection of the interior was carried out. It proved to be extremely good. Many design data, manufacturing and operational experience were obtained concerning the sodium pump by the above tests. (Japan)

6922 ANALYTICAL METHODS FOR DYNAMIC STRENGTH OF SODIUM EQUIPMENT. CALCULATION METHODS OF DYNAMIC STRENGTH OF A CYLINDRICAL SHELL AND AN AXIAL SYMMETRICAL STRUCTURE. Nagato, K. (Kawasaki Heavy Industries, Ltd., Kobe, Japan). FAPIG (Tokyo); No. 64, 222-6 (Feb 1972). (In Japanese).

In a strength analysis of equipment for sodium cooled fast breeder reactors, in addition to mechanical and thermal stress calculations for the static loads, the dynamic plastic-elastic stress analysis for dynamic pressures caused by the sodium-water reaction, run-away and other accidents, is also needed to be taken into consideration. Calculation programs DYNSHL, DANTE were developed for the necessary analyses. The outlines of the programs and the calculation examples are presented. The kinetic equations are introduced which control the response of infinite length cylinder loaded with a dynamic internal pressure, in order to obtain the approximate response characteristics of the reactor containment shell loaded with dynamic internal pressure. DYNSHL is a calculation code which was programmed for CDC-3600 using these equations. But the actual lengths of equipment are finite. Therefore, DANTE was developed based on the finite element method and modified elastic modulus method, for CDC-6600. The calculated results of DYNSHL on a cylindrical shell almost exactly agree with those of DANTE. In case of a plate, the geometrical nonlinearity caused by the element rotation must be considered, and also the unloading process must be taken into account, for stresses of some elements change from compression to tension. Programs which take into consideration these effects may be developed. (Japan)

6923 COMPRESSION AND DECOMPRESSION WAVES IN STEAM-WATER SYSTEM. Miyazaki, Keiji; Itoh, Kazumoto; Fujii-e, Yoichi; Suita, Tokuo (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 9, 560-3(Sep 1972).

Experiments were performed with steam-water mixtures to determine the wave propagation characteristics of both compression- and decompression-type pressure waves in a one-component two-phase media. These characteristics were expected to show significant nonlinearity due to mass transfer between the two phases. The experimental equipment and methods are described. Recorded data, i.e., pressure-time tracings, are presented for various pressure and temperature conditions. The results obtained should contribute to an understanding of the phenomena involved in sodium boiling which is one of the most important problems in fast reactor safety design. (L.C.L.)

6924 COLD TRAPS FOR LIQUID METAL. Swinhoe, Ronald; Hamer, Allen Norman (to United Kingdom Atomic Energy Authority). British Patent 1,285,088. 9 Aug 1972. Filed 18 Dec 1969.

Reference is made to cold purification traps for use in liquid metal heat exchange circuits. In the system described means are provided for directing the flow of liquid metal along a first flow path and in return along a second flow path, the flow paths being separated by a barrier. External cooling means are provided for cooling the liquid metal during passage through the latter part of the first flow path. The barrier means is thermally insulating in its length separating the latter part of the first flow path and the initial part of the second flow path, and thermally conducting in its length separating the initial part of the first flow path and the latter part of the second flow path. The cold trap comprises a vessel in which a cylindrical duct is arranged concentrically, whereby an annular interspace is defined between the duct and the inner wall of the vessel. Means are provided for feeding liquid metal into the vessel and directing its flow in a first flow path along the annular interspace, and then in a second flow path through the duct. Part of the duct from the liquid metal inlet end of the vessel is thermally conducting, and the remainder thermally insulating. Means are provided for externally cooling the vessel at least in the region corresponding to the insulating part of the duct. The insulating part of the duct may be of double walled construction, with an evacuated or gas filled interspace. (UK)

6925 CONTROLLING pH OF TEST REACTOR COOLANT WITH ION EXCHANGE. Holcomb, W. F.; Larrick, A. P. (Allied Chemical Corp., Idaho Falls, Idaho). Power Eng.; 76: No. 10, 38-9(Oct 1972).

A unique way of using ion exchange beds to control the pH of reactor cooling water is described. Corrosion is minimized and water is kept at a high level of purity. (auth)

6926 PREDICTION OF CARBON TRANSFER IN LMFBRs FROM EXPERIMENTAL MEASUREMENTS. Shiels, S. A.; Bagnall, C. A.; Schrock, S. L. (Westinghouse Advanced Reactors Div., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 2, 746 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6927 SIMULATION EXPERIMENTS ON HEAT TRANSFER FROM FAST REACTOR FUEL DEBRIS. Gabor, J. D.; Hesson, J. C.; Baker, L. Jr.; Cassulo, J. C. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 836(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6928 HEAT TRANSFER STUDIES FOR THE GCFR IN SWITZERLAND. Markoczy, G.; Hudina, M. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). Trans. Amer. Nucl. Soc.; 15: No. 2, 847-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6929 DESIGN AND FLOW TESTING OF THE MODEL REACTOR SUBASSEMBLIES USED IN THE HYDRAULIC CHARACTERIZATION OF THE EBR-II. Gopalakrishnan, A. (Argonne National Lab., Ill.); McGinnis, F. D. Trans. Amer. Nucl. Soc.; 15: No. 2, 861-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6930 DESIGN, CONSTRUCTION, AND COMMISSIONING OF THE EBR-II REACTOR HYDRAULIC TEST FACILITY. Cerchione, J. D. (Argonne National Lab., Idaho Falls, Idaho); McGinnis, F. D.; Long, P. M.; Rice, R. E.; Gopalakrishnan, A. Trans. Amer. Nucl. Soc.; 15: No. 2, 862-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6931 EFFECT OF WALL HEAT CAPACITY IN TRANSIENT NON-BOILING FORCED-CONVECTION HEAT TRANSFER. Nelson, M. E. (Naval Academy, Annapolis, Md.); Stein, R. P. Trans. Amer. Nucl. Soc.; 15: No. 2, 865-6(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Fuel Systems and Components

Refer also to abstracts 5403 and 5747.

6932 (EURFNR-1026) THERMAL SIMULATION OF FUEL RODS BY INDIRECTLY ELECTRICALLY HEATED RODS. Malang, S.; Rust, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). May 1972. 47p. (KFK-1587). Dep. NTIS.

For United States-Euratom Fast Reactor Exchange Program.

The example of a rod eccentrically arranged in an annulus with sodium flow was used to investigate the accuracy with which it is possible to simulate the conditions existing in an oxide-fuel rod by indirectly electrically heated rods of different geometry. For this purpose, the temperature field in the rod and in the cooling channel is calculated. The comparison is made under the assumption of a fully developed temperature profile at slug slow and pure thermal conduction in the coolant. Several theoretical assumptions often made of a constant heat flux or a constant temperature at the inner or outer surface of the cladding are included in the investigation. The study covers the influences of the material and the thickness of the electrical insulation as well as of the cladding on the quality of the simulation. Furthermore the consequences of fabrication tolerances are considered. The results are compared with results achieved on the basis of an analytical method using a defined similarity theorem. (auth) (GF)

6933 SHIELDING OF FUEL MANIPULATION SYSTEMS FOR A SODIUM-COOLED FAST REACTOR. Tanaka, Yoshihisa (First Atomic Power Industry Group, Tokyo); Suzuki, Ikunori; Tubosaka, Akira. FAPIG (Tokyo); No. 65, 18-27(May 1972). (In Japanese).

Flow of radioactive material is as follows: new fuel is taken out of storage room and loaded in reactor core. Spent fuel is taken out of the reactor core and transferred to fuel storage rack. It is carried out of a containment vessel of the reactor after cooling for 45 days. Sodium attached on the surface of the spent fuel is washed away, and the spent fuel is stored in stainless steel cans, kept in a cooling pond, and put into casks to send to the reprocessing plant. The new fuel containing plutonium, the spent fuel, and leakage from the reactor core are considered as the radiation sources. The design of equipment and instruments for shielding are discussed as well as a flow diagram. Problems in the design of shielding are pointed out. (Japan)

6934 MEASUREMENT OF GAMMA HEATING IN THE ESSOR REACTOR. Guardini, S. (CCR-EURATOM, Ispra, Italy). Energ. Nucl. (Milan); 19: No. 8-9, 515-21(1972).

A calorimetric determination of nuclear heating in the D_2O moderated, material testing reactor ESSOR is described. The measurements were performed with the aid of four isothermal calorimeters in a vertical channel of the reactor, in order to determine the specific power released by nuclear radiation in the structural materials of the reactor core vessel and in the zircaloy tubes around the control rods. (auth)

6935 FUEL ASSEMBLIES FOR FAST GAS-COOLED REACTORS. Yellowlees, J. M.; Chiarelli, G.; Libin, B.; Van Asbroeck, Ph. B. Energ. Nucl. (Paris); 14: No. 3, 161-7(1972). (In French).

Three fuel assemblies for fast gas-cooled breeder reactors proposed by GBR of Brussels are described. One of these assemblies uses stainless steel-clad vented fuel pins cooled by He. This assembly operates in a similar way to the LMFBR assembly. The cladding temperature is, however, greater and the pressure difference between the interior and the exterior of the pins equalized. The surface of the cladding is made rough in order to improve the heat conduction. The other two assemblies use beds of coated particles cooled directly by He or CO_2. This technique enables gas temperatures similar to those encountered in HTR and AGR to be reached with relatively low particle temperatures. (France)

6936 MULTIPHASE NUCLEAR FUEL CAVITY REACTOR FOR POWER GENERATION. Pinkel, B.; Gritton, E. C. (Rand Corp., Santa Monica, Calif.). J. Spacecraft Rockets; 9: No. 10, 721-2(Oct 1972).

An exploratory analysis is made of the cavity-type nuclear reactor with the fissile material (uranium or plutonium) in the various possible combinations of solid, liquid and gaseous states to determine whether a regime exists in which heat generation rates attractive for electric power systems are indicated and in which materials, and other practical problems which appear tractable. (auth)

6937 ADVANCED GAS-COOLED REACTOR SYSTEMS. Insch, G. M. (British Nuclear Design and Construction Ltd., Whetstone); Trauger, D. B. Trans. Amer. Nucl. Soc.; 15: No. 2, 600-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6938 APPLICATION OF POSTIRRADIATION DUCTILITY DATA TO FUEL ROD FAILURE LIMITS. Busboom, H. J.; Barrett, C. F.; Ring, P. J.; Spalaris, C. N. (General Electric Corp., San Jose, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 738-9 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6939 PERFORMANCE OF MIXED-OXIDE FUEL PIN WITH INTENTIONAL CLADDING DEFECT. Millhollen, M. K.; Pember, L. A.; Chastain, S. A.; Keenan, J. P. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 749-50(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6940 LINEAR HEAT RATING FOR INCIPIENT FUEL MELTING IN UO_2-PuO_2 FUEL. Leggett, R. D.; Ballard, E. O.; Baker, R. B.; Horn, G. R.; Dutt, D. S. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 752-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6941 IRRADIATION OF LOW-DENSITY SOLID AND HIGH-DENSITY ANNULAR PELLET URANIUM-PLUTONIUM CARBIDE FUEL RODS TO 77,000 MWd/T. Montgomery, M.; Strasser, A. (Gulf United Nuclear Fuels Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 2, 754-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6942 TREAT MARK-II LOOP EXPERIMENTS ON FFTF-LIKE PINS HAVING LOCAL OVERENRICHMENT. Deitrich, L. W. (Argonne National Lab., Ill.); Agrawal, A. K.; Murphy, W. F.; (and others). Trans. Amer. Nucl. Soc.; 15: No. 2, 816 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6943 EVALUATION OF WRAPPER-CAN MELTTHROUGH FOR LMFBR FUEL SUBASSEMBLIES. Pedersen, D. R.; Chawla, T. C.; van Erp, J. B. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 817-18(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6944 ALTERNATE STUDS: A NEW TYPE OF ARTIFICIAL ROUGHNESS TO IMPROVE THE PERFORMANCE OF A GAS-COOLED REACTOR. Dalle Donne, M.; Meerwald, E. (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 2, 846-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6945 VOLATILE FISSION PRODUCT MIGRATION AND PLATEOUT IN GCFR ROD IRRADIATIONS. Langer, S. (Gulf General Atomic Co., San Diego, Calif.); Baldwin, N. L.; Lindgren, J. R.; (and others). Trans. Amer. Nucl. Soc.; 15: No. 2, 850-1 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6946 POTENTIAL FAILURE OF A HEXCAN WRAPPER DUE TO THERMAL STRESSES RESULTING FROM LOCAL NON-UNIFORM TEMPERATURE DISTRIBUTIONS. Kennedy, J. M.; Chawla, T. C.; van Erp, J. B. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 852-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6947 THERMAL STRESS ANALYSIS OF A SUBASSEMBLY DUCT WALL DURING SEVERE THERMAL LOADING. Wang, P. Y.; Crawford, R. M. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 853-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6948 CALCULATIONAL CAPABILITIES FOR THE ANALYSIS OF THE SNR-300 BOWING COEFFICIENT. Madell, J. T.; Spenke, H. (Interatom, Bensberg, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 2, 854-5(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6949 EDGE-CHANNEL FLOW IN A 19-ROD LMFBR FUEL ASSEMBLY. Fontana, M. H.; MacPherson, R. E.; Gnadt,

P. A.; Parsly, L. F.; Wantland, J. L. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 855-6(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6950 EXPERIMENTAL EVALUATION OF SUBCHANNEL COOLANT CROSSFLOW IN LMFBR SUBASSEMBLIES WITH WIRE-SPACERS. van Erp, J. B.; Chawla, T. C. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 856-7(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6951 TURBULENT TRANSPORT PROPERTIES FOR THERMAL DESIGN OF LMFBR CORES. Ramm, H.; Johannsen, K. (Technische Univ., Berlin). Trans. Amer. Nucl. Soc.; 15: No. 2, 857-8(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6952 DYNAMIC EXPERIMENTS FOR HEAT TRANSFER AND MIXING STUDIES IN LMFBR FUEL ASSEMBLIES. Kerlin, T. W. (Univ. of Tennessee, Knoxville); Fry, D. N. Trans. Amer. Nucl. Soc.; 15: No. 2, 858-9(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6953 COMPARISON OF EXPERIMENTAL AND ANALYTICAL SODIUM NATURAL-CIRCULATION RESULTS. Coffield, R. D.; Miller, J. V. (Westinghouse Advanced Reactors Div., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 2, 859-60(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6954 SUBASSEMBLY INTERCHANNEL MIXING PROGRAM (SIMPLE). Henry, R. E. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 866(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6955 MIXING MODEL FOR WIRE-WRAP FUEL ASSEMBLIES. Novendstern, E. H. (Westinghouse Advanced Reactors Div., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 2, 866-7(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6956 RESULTS AND ANALYSIS OF 7-PIN WIRE-WRAP MIXING EXPERIMENTS. Lorenz, J. J.; Ginsberg, T. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 867-8 (Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6957 SELECTION OF GAS TAG COMPOSITIONS FOR LOCATING FAILED FUEL ELEMENTS IN FAST REACTORS. Boulette, E. T.; Schenter, R. E.; Schmittroth, F. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 950-1(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Auxiliary Systems, Protection Systems, and Engineered Safeguards

6958 (EUR-4880) RAPID DEPRESSURIZATION OF A THERMAL INSULATION SYSTEM FOR HIGH TEMPERATURE GAS REACTORS. Aranovitch, E.; van Asselt, D. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Nov 1972. 54p. Dep. NTIS (U. S. Sales Only). EUR B.Fr. 70,-.

The behavior of metal-foil multilayer thermal insulation bobbins under different depressurization rates was studied. These bobbins should be able to withstand, with helium under 25 atm., depressurization rates in the order of 20 atm/sec without damage. The depressurization tests are completed with different control tests such as permeability tests, X-ray photographs and metrology to evaluate modifications in the integrity of the bobbins. A mathematical model and a correlation between permeability and depressurization tests are presented. (EURATOM)

6959 MATHEMATICAL MODELS FOR SPENT-FUEL BAY PURIFICATION. Frost, C. R. (Ontario Hydro, Toronto). Trans. Amer. Nucl. Soc.; 15: No. 2, 667-9(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6960 RECOMMENDED CONSTITUTIVE EQUATIONS FOR FFTF USE AND APPLICATION TO THE ANALYSIS OF STRUCTURES. Greenstreet, W. L. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 2, 736(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Operation and Economics

Refer also to abstract 5772.

6961 ELECTRONUCLEAR ENERGY IN JAPAN. Grenon, Michel. Rev. Fr. Energ.; 23: No. 243, 439-42(Jun 1972). (In French).

The future outlook for the Japanese electronuclear program is reviewed in relation to the energy requirements predicted from the present day until the end of the century. The currently existing light water reactors and the programs put forward for thermal and fast reactors are examined. (France)

6962 FUEL MANAGEMENT AND ECONOMICS. Vendryes, G. A. (CEN de Saclay, Gif-sur-Yvette, France); Ravier, J.; Guillet, H.; Labrousse, M.; Michel, P. Trans. Amer. Nucl. Soc.; 15: No. 2, 587-8(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6963 APPLICATION OF MODELING METHODS TO FUEL CYCLE ENVIRONMENTAL IMPACT ANALYSIS. Brewer, S. T.; Livingston, R. A. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 659-60(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Safety and Siting

Refer also to abstract 6782.

6964 (AEC-tr-7340) DETERMINISM AND STATISTICS IN REACTOR SAFETY. Knecht, O. Translated from Atomwirt., Atomtech.; 15: No. 11, 528-30(1970). 7p. Dep. NTIS.

Problems of reactor safety are discussed from the standpoint of determinism and probability. In the case of serious reactor accidents, radiation detectors should indicate doses prevailing within the containment vessel. Instruments for such high dose rates, however, are not available commercially. They should be designed for pressure and temperature conditions existing in serious reactor accidents. 10 references. (H.B.G.)

6965 SOME PRELIMINARY CONSIDERATIONS RELATING TO AN EQUATION OF STATE FOR IRRADIATED NUCLEAR FUEL. Brook, A. J. (United Kingdom Atomic Energy Authority, Risley, Eng.). Nucl. Safety; 13: No. 6, 467-77(1972).

The calculation of energy release resulting from severe excursions in fast reactors demands a knowledge of the equation of state of reactor fuel. The modifying effects that fission products may produce on pressure-temperature relations and some of the major uncertainties in the physical and chemical behavior of the fission products are discussed. Attention is drawn to the importance of reactor conditions at the initiation of the superprompt excursion, and an indication is given of the effects of fission-product pressures on nuclear excursion yields and containment requirements. (9 references) (auth)

6966 RADIOLYTIC HYDROGEN GENERATION AFTER LOSS-OF-COOLANT ACCIDENTS IN WATER-COOLED POWER REACTORS. Zittel, H. E. Nucl. Safety; 13: No. 6, 459-67(1972).

The radiolytic generation of hydrogen from the pressure-suppression coolant liquid following a loss-of-coolant accident in light-water-cooled power reactors is an important consideration since it could conceivably result in a hazardous condition. Studies carried out on the probable radiolytic hydrogen generation in both the PWR and BWR accident cases have been instrumental in establishing a base from which to consider this point. A review of the experimental work and the conclusions arising from the work are given. (8 references) (auth)

6967 ISPRA'S CONTRIBUTION TO REACTOR SAFETY. Randles, J. Nucl. Safety; 13: No. 6, 451-8(1972).

Euratom's Joint Research Centre at Ispra has had for several years an extensive program in reactor-safety research and development. In the fast reactor safety field, it included work on the interaction between uranium dioxide and sodium and on the dynamic loading of liquid-metal-cooled fast breeder reactor containment. Research in support of water-reactor safety covers depressurization and emergency-core-cooling-system studies. A more generalized research effort is under way in the areas of reactor dynamics, reliability theory, early failure detection, and fracture mechanics and pipe rupture. (auth)

6968 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Sheldon, M. (comp. and ed.). Nucl. Safety; 13: No. 6, 494-502(1972).

6969 ELEMENTS OF FAULT TREE CONSTRUCTION: A NEW APPROACH. Fussell, J. B. (Georgia Inst. of Tech., Atlanta); Vesely, W. E.; Clement, J. D. Trans. Amer. Nucl. Soc.; 15: No. 2, 794(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6970 RELIABILITY ANALYSIS: A TOTALLY AUTOMATED PROBABILISTIC APPROACH. Borchard, J. H.; Fussell, J. B. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 15: No. 2, 794-5(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6971 PRESSURE PULSE ON SUBASSEMBLY WALL DUE TO A LOCAL MOLTEN FUEL-COOLANT INTERACTION. Padilla, A. Jr.; Marciniak, T. J.; Crawford, R. M. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 809(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6972 FUEL-COOLANT INTERACTION AND DIFFERENTIAL MOTION EFFECTS IN LMFBR DISASSEMBLY CALCULATIONS. Jackson, J. F. (Argonne National Lab., Ill.); Nicholson, R. B. Trans. Amer. Nucl. Soc.; 15: No. 2, 810(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6973 FUEL-COOLANT INTERACTIONS FOLLOWING A VOIDED-CORE DISASSEMBLY. Cho, D. H. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 810-11(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6974 USE OF SATURATED LIQUID SODIUM PROPERTIES IN FUEL-COOLANT INTERACTION ANALYSIS. Erdman, C. A.; Garner, P. L.; Reynolds, A. B. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 15: No. 2, 811-12(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6975 SODIUM DROPLET COMBUSTION MODEL FOR REACTOR ACCIDENT ANALYSIS. Shire, P. R. (Westinghouse Hanford Co., Richland, Wash.); Hale, J. P.; Omberg, R. P.; Peterson, R. E.; Babb, A. L. Trans. Amer. Nucl. Soc.; 15: No. 2, 812-13(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6976 ROLE OF NUCLEATION IN VAPOR EXPLOSIONS. Fauske, H. K. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 813-14(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6977 EFFECT OF NONCONDENSIBLES ON THE RATE OF SODIUM-VAPOR CONDENSATION FROM A SINGLE-RISING HCDA BUBBLE. Theofanous, T. G.; Fauske, H. K. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 814-15(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6978 CALCULATION OF THE DYNAMIC RESPONSE OF THE PRIMARY CONTAINMENT USING A TWO-DIMENSIONAL HYDRODYNAMIC-ELASTIC-PLASTIC COMPUTER CODE. Chang, Y. W.; Gvildys, J.; Fistedis, S. H. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 818-19(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6979 APPLICATION OF THE PAD CODE TO LMFBR POWER TRANSIENT STUDIES. Engle, L. B.; Stratton, W. R.; Peterson, D. M. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 820(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6980 SPACE-ENERGY-DEPENDENT FAST REACTOR DISASSEMBLY ANALYSIS. Smith, L. L. (Argonne National Lab., Ill.); Ott, K. O. Trans. Amer. Nucl. Soc.; 15: No. 2, 821-2(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6981 CRITERION FOR FREE-CONTACT FRAGMENTATION OF HOT MOLTEN MATERIALS IN COOLANTS. Kazimi, M. S.; Todreas, N. E.; Lanning, D. D.; Rohsenow, W. M. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 15: No. 2, 835(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6982 EXPERIMENTAL INVESTIGATION OF SODIUM BOILING PROCESSES CAUSED BY LOCAL BLOCKAGES. Schleisiek, K. (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 2, 838(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6983 PREVENTION OF LOCAL FAULT PROPAGATION IN THE LMFBR. Gast, K. (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 2, 838-9(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6984 PROTECTION AGAINST LOCAL CORE MALFUNCTIONS IN LMFBR'S. van Erp, J. B.; Pedersen, D. R. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 839-40(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6985 RESPONSE OF THE GCFR DEMONSTRATION PLANT TO DEPRESSURIZATION ACCIDENTS. Buttemer, D. R.; Hopkins, H. C. (Gulf General Atomic Co., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 848-9(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6986 RAPID LOSS OF PRESSURE IN A GCFR PLANT USING A DIRECT CYCLE. Dupont, J. F.; Sarlos, G.; Tiberini, A. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). Trans. Amer. Nucl. Soc.; 15: No. 2, 849-50(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6987 HEAT TRANSFER FROM BOILING POOLS WITH INTERNAL HEAT GENERATION. Hesson, J. C.; Gunther, W. H. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 864-5(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Commercial Power Reactors

6988 WORLD'S REACTORS: No. 58 GENTILLY. Nucl. Eng. Int.; 17: No. 198, 932(Nov 1972).
A pull-out wall chart is presented which comprises a large colored sectional drawing of the Gentilly nuclear power station and a list of all main parameters. (UK)

6989 PWR REACTORS IN GERMAN FEDERAL REPUBLIC. Knoedler, D. (Siemens AG, Erlangen, Ger.). Energ. Nucl. (Paris); 14: No. 3, 180-9(1972). (In French).
Three different types of systems are used in the prototype PWR operating in West Germany. Pressurized water nuclear plants having a maximum power of 1300 MW(e) were ordered by different nationalized concerns distributing energy. In January 1972, the first nuclear plant operating on a purely commercial basis was put into operation. This plant has a 660 MW(e) power output. Power plants working on the same system having a total power of 4600 MW(e) are under construction. Pressurized water reactors constructed in West Germany operate satisfactorily. (France)

6990 TECHNICAL PROBLEMS OF A MULTI-PURPOSE LIGHT WATER REACTOR. USE OF LIGHT WATER REACTOR TO CHEMICAL INDUSTRY. Yabe, G. (Asahi Chemical Industry Co. Ltd., Osaka). Genshiryoku Kogyo; 18: No. 4, 14-17(Apr 1972). (In Japanese).
The chemical industry consumes large quantities of energy and steam. A model for the combination of petro-chemical industry with a nuclear power plant is proposed. It is assumed that the petro-chemical industry in 1985 will process 2 million ton/year calculated in terms of ethylene. A multi-purpose reactor can produce electric power of 1,000 MW, process steam of 4,000 t/h, and desalted water of 500,000 m^3/d, and can supply them to the petro-chemical plants. Merits in the use of a light water reactor for the chemical industry are discussed. Examples of the combination of nuclear power plants and chemical industry in foreign countries are introduced. (Japan)

6991 EDUCATING HIGH SCHOOL TEACHERS ON NUCLEAR POWER. Sandquist, G. M. (Univ. of Utah, Salt Lake City); Kunze, J. F. Trans. Amer. Nucl. Soc.; 15: No. 2, 637-8(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Physics and Core Engineering

6992 COMPARISON OF TWO- AND THREE-DIMENSIONAL CALCULATIONS OF SUPERPROMPT CRITICAL EXCURSION.

Birkhofer, A.; Schmidt, A.; Werner, W. (Technische Univ., Garching, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 2, 832-3(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6993 PRATICAL XENON SPATIAL CONTROL BASIC CONCEPTS, COMPUTER SIMULATIONS, AND POINT BEACH TESTS. Bauer, D. C. (Westinghouse Electric Corp., West Mifflin, Pa.); Newton, R. A.; Poncelet, C. G.; Impink, A. J.; Jones, K. A. Trans. Amer. Nucl. Soc.; 15: No. 2, 887-8(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6994 TRANSIENT XENON IN PLUTONIUM RECYCLE FUELED REACTORS. Galan, V. J.; Delano, B. J.; Brown, L. E. (Babcock and Wilcox, Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 15: No. 2, 923(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6995 DETECTION OF SMALL VOIDS IN NUCLEAR REACTORS BY COHERENCE METHODS. McCamant, R. R.; Albrecht, R. W. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 15: No. 2, 924-5(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

6996 BELGIAN PLUTONIUM RECYCLE PROGRAM: FINAL EXPERIMENTAL ASSESSMENT OF THE METHODS OF PHYSICS CALCULATIONS. Bindler, L. (Belgonucleaire SA, Brussels); Charlier, A.; Vandenberg, Cl.; (and others). Trans. Amer. Nucl. Soc.; 15: No. 2, 954-6(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Control Elements, Systems, and Instrumentation

6997 (AECL-4310) SURGING MOTION OF A FLUID BETWEEN A VERTICAL PIPE AND A RESERVOIR. Selander, W. N.; Veeder, J. I. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Oct 1972. 43p. Dep. NTIS (U. S. Sales Only). AECL $1.00.
The problem of water oscillating freely between a vertical pipe and a connected reservoir was examined. The predictions of a theoretical model were in good agreement with experimental results. Both the theory and the experiment devised to check the theory are discussed in some detail. The problem is directly related to the design of gravity-operated liquid shut-down systems for nuclear reactors. An example is given at the end of the text to indicate the rate of insertion obtainable with this type of system in a CANDU size reactor. (auth)

6998 GENTILLY STATION CONTROL SYSTEM DESIGN. Nucl. Eng. Int.; 17: No. 198, 933-4(Nov 1972).
The control philosophy adopted for the Gentilly CANDU-BLW is one of "load-follows-reactor." Basically, the operator demands a certain reactor power and the power control system regulates the reactor to satisfy that demand. The turbine and bypass load control system acts to maintain constant steam drum pressure, and in so doing, matches the power absorbed by the turbine and/or the condenser unit to the power produced by the nuclear reactor. (auth)

6999 STUDY OF NUCLEAR POWER PLANT DYNAMICS BY FLUCTUATION ANALYSIS AND PSEUDORANDOM INPUT ANALYSIS. Boyter, N. C. Jr. (Army Ballistic Research Labs., Aberdeen Proving Ground, Md.); Kympton III, H. W.; Warren, L. W.; (and others). Trans. Amer. Nucl. Soc.; 15: No. 2, 870(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7000 COMPUTER-BASED COMMUNICATION SYSTEM FOR NUCLEAR POWER PLANTS. Lunde, J. E. (Institutt for Atomenergi, Halden, Norway); Netland, K.; Sletvold, B. Trans. Amer. Nucl. Soc.; 15: No. 2, 883-4(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Containment Systems, Shielding, Waste Processing, and Radiation Protection

7001 CONTAINMENT SYSTEMS AND STRUCTURES. Brush, H. F.; Halligan, D. W. (Bechtel Corp., San Francisco). Trans. Amer. Nucl. Soc.; 15: No. 2, 592-3(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7002 SAFETY MARGIN PHILOSOPHY IN PRESSURE-TEMPERATURE TRANSIENT CALCULATIONS FOR CONTAINMENTS. Savery, C. W. (Drexel Univ., Philadelphia); Kowal, G. M. Trans. Amer. Nucl. Soc.; 15: No. 2, 833-4(Nov 1972).
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7003 REGRESSION APPROACH OF CALCULATING CONTAINMENT BUILDING LEAK RATE. Kowal, G. M.; Sommer, W. C. (Gilbert Associates, Inc., Reading, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 2, 888-9(Nov 1972).
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7006 THREE-DIMENSIONAL KINETIC ANALYSIS OF AN ASYMMETRIC BORON DILUTION IN A PWR CORE. Salah, S.; Rossi, C. E.; Geets, J. M. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 15: No. 2, 831-2(Nov 1972).
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Auxiliary Systems, Protection Systems, and Engineered Safeguards

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Operation and Economics

7017 (DOCKET-50003-143) INDIAN POINT STATION, UNIT 1. Exposure of Individual to Radiation. (Consolidated Edison Co. of New York, Inc., New York). 22 Nov 1972. 3p. Dep. NTIS.

7018 (DOCKET-50016-175) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Report for September 1972. (Power Reactor Development Co., Detroit Mich.). Sep 1972. 21p. (PRDC-EF-109). Dep. NTIS.

7019 (DOCKET-50029-214) YANKEE NUCLEAR POWER STATION. Technical Specifications, Change 104. (Directorate of Licensing (AEC), Washington, D. C.). 15 Nov 1972. 3p. Dep. NTIS.
Revised technical specifications are presented concerning the Core 10 control rod withdrawal sequence. (D.C.C.)

7020 (DOCKET-50133-100) HUMBOLDT BAY POWER PLANT, UNIT 3. Analysis of Independence of Units 1 and 2; Technical Specifications, Proposed Change 42. (Pacific Gas and Electric Co., San Francisco, Calif.). 15 Nov 1972. 7p. Dep. NTIS.
Revised technical specifications are presented concerning the availability requirements for the diesel powered fire pump. (D.C.C.)

7021 (DOCKET-50213-167) HADDAM NECK PLANT, UNIT 1. Operation Report No. 72-10 for the Month of October. (Connecticut Yankee Atomic Power Co., Haddam). 27 Nov 1972. 15p. (NYO-3144-77). Dep. NTIS.

7022 (DOCKET-50237-282) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Main Steam Line Low Pressure Switches Reset. (Commonwealth Edison Co., Morris, Ill. (USA)). 21 Nov 1972. 3p. (DOCKET-50249-173). Dep. NTIS.

7023 (DOCKET-50237-283) DRESDEN NUCLEAR POWER STATION, UNIT 2. Local Leak Rate Tests of Primary Containment Penetrations. (Commonwealth Edison Co., Chicago, Ill.). 29 Nov 1972. 3p. Dep. NTIS.

7024 (DOCKET-50237-284) DRESDEN NUCLEAR POWER STATION, UNIT 2. Main Steam Line Low Pressure Switch Calibration. (Commonwealth Edison Co., Chicago, Ill.). 29 Nov 1972. 2p. Dep. NTIS.

7025 (DOCKET-50244-128) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Comments Concerning Items of Noncompliance Brought to Attention Following Inspection of July 31, 1972. (Rochester Gas and Electric Corp., N. Y.). 30 Oct 1972. 5p. Dep. NTIS.
Information is presented concerning the noncompliance to technical specifications for reporting the discovery of collapsed fuel elements. (D.C.C.)

7026 (DOCKET-50245-174) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Vacuum Breaker Instruments Setpoints Checked. (Millstone Point Co., Hartford, Conn.). 29 Nov 1972. 1p. Dep. NTIS.

7027 (DOCKET-50249-174) DRESDEN NUCLEAR POWER STATION, UNIT 3. Valves Had a Leakage Rate Greater Than Specified for Single Penetration. (Commonwealth Edison Co., Chicago, Ill.). 15 Nov 1972. 2p. Dep. NTIS.

7028 (DOCKET-50249-175) DRESDEN NUCLEAR POWER STATION, UNIT 3. Main Steam Line Low Pressure Switch Calibration. (Commonwealth Edison Co., Chicago, Ill.). 29 Nov 1972. 2p. Dep. NTIS.

7029 (DOCKET-50254-141) QUAD-CITIES STATION, UNITS 1 AND 2. Valve 1-203-2D Would Not Close Properly. (Commonwealth Edison Co., Cordova, Ill.). 16 Nov 1972. 2p. (DOCKET-50265-133). Dep. NTIS.

7030 (DOCKET-50254-145) QUAD-CITIES STATION, UNIT 1. Two Switches Found to Have Drifted Beyond the Technical Specification Limit. (Commonwealth Edison Co., Cordova, Ill.). 25 Nov 1972. 2p. Dep. NTIS.

7031 (DOCKET-50255-116) PALISADES PLANT. Monthly Primary and Secondary Radioactivity and Effluent Report, October 1972. (Consumers Power Co., Jackson, Mich.). 29 Nov 1972. 2p. Dep. NTIS.

7032 (DOCKET-50261-127) H. B. ROBINSON UNIT 2. Monthly Report of Primary and Secondary Activity Measurements and Effluent Discharge Activity Levels. (Carolina Power and Light Co., Raleigh, N. C.). 20 Nov 1972. 2p. Dep. NTIS.

7033 (DOCKET-50261-129) H. B. ROBINSON UNIT 2. Environmental Monitoring Report, April 1-September 30, 1972. (Eberline Instrument Corp., Santa Fe, N. Mex. Dept. of Nuclear Sciences). 30 Nov 1972. 45p. Dep. NTIS.
For Carolina Power and Light Co., Raleigh, N. C.

7034 (DOCKET-50261-130) H. B. ROBINSON UNIT 2. Routine Operating Report No. 4, April 1-September 30, 1972. (Carolina Power and Light Co., Raleigh, N. C.). 30 Nov 1972. 161p. Dep. NTIS.

7035 (DOCKET-50261-131) H. B. ROBINSON UNIT 2. Technical Specifications, Proposed Revisions. (Carolina Power and Light Co., Raleigh, N. C.). 30 Nov 1972. 18p. Dep. NTIS.
Revisions are proposed to the reporting requirements for both routine and non-routine operations. (H.D.R.)

7036 (DOCKET-50265-136) QUAD-CITIES STATION, UNIT 2. Drift in Trip Level Settings. (Commonwealth Edison Co., Cordova, Ill.). 21 Nov 1972. 5p. Dep. NTIS.

7037 (DOCKET-50271-115) VERMONT YANKEE NUCLEAR POWER STATION. Incident Involving Control Rods. (Vermont Yankee Nuclear Power Corp., Rutland). 27 Oct 1972. 3p. Dep. NTIS.

7038 (DOCKET-50271-120) VERMONT YANKEE NUCLEAR POWER STATION. Gaseous Release Activity Level. (Vermont Yankee Nuclear Power Corp., Rutland). 1 Dec 1972. 2p. Dep. NTIS.

7039 (DOCKET-50289-79) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Reactor Coolant System Contamination. (Metropolitan Edison Co., Reading, Pa.). [nd]. 3p. (DOCKET-50320-37). Dep. NTIS.

7040 (DOCKET-50309-82) MAINE YANKEE ATOMIC POWER STATION. Inadvertant Initiation of Safety Injection, October 31, 1972. (Maine Yankee Atomic Power Co., Wiscasset). 29 Nov 1972. 1p. Dep. NTIS.

7041 (DOCKET-50331-62) DUANE ARNOLD ENERGY CENTER. Operating Pressure and Temperature Limitations. (Iowa Electric Light and Power Co., Cedar Rapids). 1 Nov 1972. 1p. Dep. NTIS.

7042 (DOCKET-50331-66) DUANE ARNOLD ENERGY CENTER. Reports of Environmental Monitoring Program, April 1-June 30, 1972. (Eberline Instrument Corp., Santa Fe, N. Mex. Dept. of Nuclear Sciences). 1972. 47p. Dep. NTIS.
For Iowa Electric Light and Power Co., Cedar Rapids.

7043 (DOCKET-50331-67) DUANE ARNOLD ENERGY CENTER. Reports of Environmental Monitoring Program, April 1971-March 1972. (Iowa Electric Light and Power Co., Cedar Rapids). 20 Nov 1972. 213p. Dep. NTIS.

7044 (DOCKET-50334-46) BEAVER VALLEY POWER STATION, UNIT 1. Fire at Motor Control Center 1-E6. (Duquesne Light Co., Pittsburgh, Pa.). 24 Oct 1972. 8p. Dep. NTIS.

7045 (DOCKET-50409-24) LA CROSSE BOILING WATER REACTOR. Incident Report DPC-72-14, Correction. (Dairyland Power Cooperative, La Crosse, Wis.). 16 Nov 1972. 1p. Dep. NTIS.
Corrected information is presented concerning the inspection of brake assemblies for control rod drives. (D.C.C.)

7046 (DOCKET-50409-25) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report for August 1972. (Dairy-

land Power Cooperative, La Crosse, Wis.). 1 Dec 1972. Contract AT(11-1)-851. 32p. (DPC-851-47). Dep. NTIS.

7047 ASPECTS OF THE IMPORTANCE OF NUCLEAR POWER PLANTS IN THE ELECTRICITY PRODUCTION. Belot, F. R. (Centrales Electriques, Liege). RUM, Rev. Universelle Mines; 115: No. 2, 53-60(1972). (In French).

7048 GENTILLY: COMMISSIONING AND EARLY OPERATION. Taylor, M. L. (Atomic Energy of Canada Ltd., Ottawa); Therrien, M. Nucl. Eng. Int.; 17: No. 198, 929-32(Nov 1972).

The Gentilly nuclear power station is a 250 MW(e) prototype of the CANDU-BLW system and the first natural uranium fueled reactor using light water coolant. Principal design features are summarized and the first 18 months operating experience from criticality to full power is described. Problems encountered during commissioning, which included a coolant pump failure and flux tilting are described. Notable features were the excellent performance of the on-power fuelling machine, very good chemical control of the coolant water and the low-levels of radiation associated with the turbine. (UK)

7049 SET THEORETICAL APPROACH TO ASSESS THE RELATIVE ECONOMICS OF A DOUBLE UNIT AND A SINGLE UNIT NUCLEAR POWER STATION. Balakrishnan, M. R. (Bhabha Atomic Research Centre, Bombay). Energ. Nucl. (Milan); 19: No. 8-9, 509-14(1972).

Relative economics of a double unit and a single unit nuclear power station of the same capacity are analyzed, exploring the effect of the utilization factor under various load factors on the energy generation cost. Probability theory and set theory are applied to obtain the utilization factors of the single unit and double unit stations. A specific example of a 500 MWe CANDU power station is presented to illustrate the method. (auth)

7050 FUEL CYCLE AND POWER GENERATION. Uematsu, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Trans. Amer. Nucl. Soc.; 15: No. 2, 594(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7051 NUCLEAR FUEL AND POWER MANAGEMENT. Hoskins, R. E. (Tennessee Valley Authority, Chattanooga); Kiefer, W. M.; Koncel, E. F. Trans. Amer. Nucl. Soc.; 15: No. 2, 596-7 (Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7052 CHAIRMAN'S REMARKS. Kuffer, K. (Nordostschweizerische Kraftwerke AG, Baden, Switzerland). Trans. Amer. Nucl. Soc.; 15: No. 2, 599(Nov 1972).

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7053 CONSTRUCTION AND OPERATING EXPERIENCE WITH THERMAL POWER REACTORS OUTSIDE THE U. S. Stolz, J. (Electricite de France, Paris). Trans. Amer. Nucl. Soc.; 15: No. 2, 599-600(Nov 1972).

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7054 CONSTRUCTION AND OPERATING EXPERIENCE WITH THERMAL POWER REACTORS WITHIN THE UNITED STATES. Kemper, John S. (Philadelphia Electric Co.). Trans. Amer. Nucl. Soc.; 15: No. 2, 600(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7055 POWER PLANT OPERATION TRAINING FOR NUCLEAR ENGINEERING TECHNOLOGY STUDENTS. Hornyik, K. (Oregon State Univ., Corvallis). Trans. Amer. Nucl. Soc.; 15: No. 2, 636(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7056 ASSESSMENT OF LIMITATIONS TO FAST BREEDER REACTOR DEPLOYMENT. O'Hara, F. A. (Monsanto Research Corp., Miamisburg, Ohio); Leonard, J. H. Trans. Amer. Nucl. Soc.; 15: No. 2, 657(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7057 EFFECT OF FUEL CYCLE PARAMETERS ON FUEL RELEASES. Wise, K. R. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 659(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7058 ASSESSING THE EXTERNAL COSTS ASSOCIATED WITH COMPETING FUEL CYCLES. Brewer, S. T.; Livingston, R. A. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 661(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7059 CONSTRUCTION AND OPERATING EXPERIENCE WITH THERMAL POWER REACTORS IN CANADA. McConnell, L. G. (Ontario Hydro, Toronto). Trans. Amer. Nucl. Soc.; 15: No. 2, 841(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7060 FRENCH NUCLEAR PLANTS. Leo, M. B. M. (Electricite de France, Paris). Trans. Amer. Nucl. Soc.; 15: No. 2, 841-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7061 CONSTRUCTION AND OPERATING EXPERIENCE OF LWRs IN GERMANY. Weckesser, A.; Eickelpasch, N. (Kernkraft RWE-Bayernwerk GmbH, Gundremmingen, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 2, 842-3(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

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7063 OPERATION AND CONSTRUCTION EXPERIENCE OF NUCLEAR POWER GENERATING STATIONS IN JAPAN. Itoh, T. (Kansai Electric Power Co., Inc., Osaka). Trans. Amer. Nucl. Soc.; 15: No. 2, 844(Nov 1972).

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7064 STARTUP OPERATING EXPERIENCE: FORT ST. VRAIN UNIT NO. 1. Swart, F. E. (Public Service Co. of Colorado, Denver). Trans. Amer. Nucl. Soc.; 15: No. 2, 890-1(Nov 1972).

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7066 OYSTER CREEK STATION OPERATING EXPERIENCE. Finfrock, I. R. Jr. (Jersey Central Power and Light Co., Morristown, N. J.). Trans. Amer. Nucl. Soc.; 15: No. 2, 891(Nov 1972).

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7067 RECENT OPERATING EXPERIENCE AT DRESDEN STATION. Worden, W. P. (Commonwealth Edison Co., Morris, Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 891-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7068 PERFORMANCE AND SELECTED EXPERIENCES AT TWO OPERATING NUCLEAR PLANTS IN CONNECTICUT. Sides, W. M. (Northeast Utilities Service Co., Hartford). Trans. Amer. Nucl. Soc.; 15: No. 2, 892(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7069 ROCHESTER GAS AND ELECTRIC CORPORATION R. E. GINNA: UNIT NO. 1. Arthur, J. E. (Rochester Gas and Electric Co., N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 2, 892-3(Nov 1972).

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Safety and Siting

Refer also to abstracts 5186 and 5400.

7070 (DOCKET-50003-142) INDIAN POINT STATION, UNIT 1. Reanalysis of Piping Stresses Indicated Valve Support to be Unnecessary. (Consolidated Edison Co. of New York, Inc., New York). 27 Nov 1972. 3p. Dep. NTIS.

7071 (DOCKET-50029-215) YANKEE NUCLEAR POWER STATION. Technical Specifications, Proposed Change 105. (Yankee Atomic Electric Co., Westboro, Mass.). 27 Nov 1972. 12p. Dep. NTIS.

Revised technical specifications are presented concerning operating procedures and reporting requirements for abnormal occurrences in plant operation. (D.C.C.)

7072 (DOCKET-50206-176) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Technical Specifications, Proposed Changes 12 and 13. (Southern California Edison Co., Rosemead, Calif.). 27 Nov 1972. 21p. Dep. NTIS.

Revised technical specifications are presented concerning reporting requirements for reactor operations. (D.C.C.)

7073 (DOCKET-50213-166) HADDAM NECK PLANT, UNIT 1. Disagreement with Method Used for Determining Operating Limit Curves. (Directorate of Licensing (AEC), Washington, D. C.). 15 Nov 1972. 2p. Dep. NTIS.

7074 (DOCKET-50220-116) NINE MILE POINT NUCLEAR STATION, UNIT 1. Inadvertent Turbine Trip on November 19, 1972. (Niagara Mohawk Power Corp., Lycoming, N. Y.). 29 Nov 1972. 15p. Dep. NTIS.

7075 (DOCKET-50237-273) DRESDEN NUCLEAR POWER STATION, UNIT 2. Request That Environmental Report and Supplements Submitted for Dresden Unit 3 Apply to Unit 2 as Well. (Commonwealth Edison Co., Chicago, Ill.). 27 Oct 1972. 2p. Dep. NTIS.

7076 (DOCKET-50244-127) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Changes in Restrictions of Table 1 of June 22, 1972 Submittal. (Directorate of Licensing (AEC), Washington, D. C.). 8 Nov 1972. 1p. Dep. NTIS.

Revised technical specifications are presented concerning restrictions for Cycle 3 operation. (D.C.C.)

7077 (DOCKET-50244-129) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Provisional Operating License DPR-18, Amendment 3. (Directorate of Licensing (AEC) Washington, D. C.). 15 Nov 1972. 2p. Dep. NTIS.

7078 (DOCKET-50245-173) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Technical Specifications, Proposed Change. (Millstone Point Co., Hartford, Conn.). 29 Nov 1972. 3p. Dep. NTIS.

Revised technical specifications are presented concerning the control rod withdrawal sequence. (D.C.C.)

7079 (DOCKET-50255-113) PALISADES PLANT. Special Report No. 3, Additional Information. (Consumers Power Co., Jackson, Mich.). 16 Nov 1972. 5p. Dep. NTIS.

Additional information is presented concerning the moderator temperature coefficient. (D.C.C.)

7080 (DOCKET-50255-114) PALISADES PLANT. Interim Special Technical Specifications, Additional Information. (Consumers Power Co., Jackson, Mich.). 21 Nov 1972. 2p. Dep. NTIS.

Additional information is presented concerning loss of coolant accident analysis. (D.C.C.)

7081 (DOCKET-50259-70) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Main Steam Isolation Valves. (Tennessee Valley Authority, Chattanooga). 17 Nov 1972. 17p. (DOCKET-50260-66; DOCKET-50296-63). Dep. NTIS.

7082 (DOCKET-50261-125) H. B. ROBINSON UNIT 2. Facility Operating License DPR-23, Amendment 2. (Directorate of Licensing (AEC), Washington, D. C.). 15 Nov 1972. 2p. Dep. NTIS.

7083 (DOCKET-50263-162) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Technical Specifications, Change Request, November 20, 1972. (Northern States Power Co., Minneapolis, Minn.). 6 Dec 1972. 42p. Dep. NTIS.

Revised technical specifications are presented concerning reporting requirements for plant operations. (D.C.C.)

7084 (DOCKET-50271-116) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrences AO-72-10 and AO-72-11 and Fire on November 8, 1972. (Vermont Yankee Nuclear Power Corp., Rutland). 9 Nov 1972. 4p. Dep. NTIS.

A scram discharge volume high water level switch failure, a release of radioactive material from the stack monitoring room, and fire damage to an auxiliary transformer are reported. (H.D.R.)

7085 (DOCKET-50280-91) SURRY POWER STATION, UNIT 1. Technical Specification 4.4-B Modification. (Virginia Electric and Power Co., Richmond). 10 Nov 1972. 3p. Dep. NTIS.

Revised technical specifications are presented concerning the pressure required for leak rate testing of the containment structure. (D.C.C.)

7086 (DOCKET-50280-92) SURRY POWER STATION, UNIT 1. Steps Taken to Correct Items of Noncompliance Brought to Attention in Letter Dated September 12, 1972. (Virginia Electric and Power Co., Richmond). 4 Oct 1972. 5p. Dep. NTIS.

Information is presented concerning the decay heat removal system and operating procedures. (D.C.C.)

7087 (DOCKET-50280-93) SURRY POWER STATION, UNITS 1 AND 2. Additional Information on Mixing in Subcompartments of Containments. (Virginia Electric and Power Co., Richmond). 29 Nov 1972. 2p. (DOCKET-50281-79). Dep. NTIS.

7088 (DOCKET-50282-84) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. KEWAUNEE NUCLEAR POWER PLANT. Main Steam and Feedwater Line Rupture Study. (Pioneer Service and Engineering Co., Chicago, Ill.). 22 Nov 1972. 17p. (DOCKET-50306-80; DOCKET-50305-58). Dep. NTIS.

7089 (DOCKET-50295-73) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Order Extending Completion Date. (Directorate of Licensing (AEC), Washington, D. C.). 28 Nov 1972. 2p. Dep. NTIS.

7090 (DOCKET-50298-59) COOPER NUCLEAR STATION. Discussion of Apparent Violation Brought to Attention by Letter of October 12, 1972. (Nebraska Public Power District, Columbus). 2 Nov 1972. 23p. Dep. NTIS.

The actions taken following discovery of electrical wiring errors in the reactor protection system are described. (H.D.R.)

7091 (DOCKET-50302-58) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Steps Taken to Correct Items of Noncompliance Brought to Attention in Letters of July 24, 1972 and October 11, 1972. (Florida Power Corp., St. Petersburg). 24 Nov 1972. 17p. Dep. NTIS.

Additional information is presented concerning quality control procedures for construction of the reactor. (D.C.C.)

7092 (DOCKET-50313-59) ARKANSAS NUCLEAR ONE, UNIT 1. Final Safety Analysis Report, Amendment 32. (Arkansas Power and Light Co., Little Rock). 30 Nov 1972. 28p. Dep. NTIS.

Revised and requested data are presented concerning structures, piping systems, and core physics. (D.C.C.)

7093 (DOCKET-50315-90) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Effect of Failure on Non-Category I (Seismic) Equipment on Other Safety Related Equipment. (Indiana and Michigan Power Co., New York). 10 Nov 1972. 4p. (DOCKET-50316-90). Dep. NTIS.

7094 (DOCKET-50315-91) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Supplementary Environmental Information. (Indiana and Michigan Power Co., New York). 29 Nov 1972. 47p. (DOCKET-50316-91). Dep. NTIS.

7095 (DOCKET-50317-68) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Action to be Taken to Correct Item of Noncompliance Brought to Attention Following Inspection, September 5, 6, and 8, 1972. (Baltimore Gas and Electric Co., Md.). 3 Nov 1972. 6p. (DOCKET-50318-65). Dep. NTIS.

The reporting requirements for the failure of three 125 volt dc battery chargers are discussed. (H.D.R.)

7096 (DOCKET-50317-71) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 30. (Baltimore Gas and Electric Co., Md.). 22 Nov 1972. 37p. (DOCKET-50318-68). Dep. NTIS.

Additional information is presented concerning the repair of upper vertical tendon bearing plates of the containment structure. (D.C.C.)

7097 (DOCKET-50317-72) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Repair of Voids Found in Concrete Underneath Upper Tendon Bearing Plates. (Baltimore Gas and Electric Co., Md.). 22 Nov 1972. 1p. (DOCKET-50318-69). Dep. NTIS.

7098 (DOCKET-50321-59) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Steps Taken to Correct Items of Noncompliance Brought to Attention in Letter Dated September 15, 1972. (Georgia Power Co., Atlanta). 14 Nov 1972. 8p. Dep. NTIS.

Additional information is presented concerning the cable trays of the electrical system, quality control procedures, wall thickness verification for nuclear service valves, and construction procedures. (D.C.C.)

7099 (DOCKET-50321-60) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Final Safety Analysis Report, Amendment 23. (Georgia Power Co., Atlanta). 29 Nov 1972. 19p. Dep. NTIS.

Revised and requested data are presented concerning core physics and containment system. (D.C.C.)

7100 (DOCKET-50323-25) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 2. Construction Permit No. CPPR-69, Amendment 1. (Directorate of Licensing (AEC), Washington, D. C.). 29 Nov 1972. 4p. Dep. NTIS.

7101 (DOCKET-50331-65) DUANE ARNOLD ENERGY CENTER. Cedar River Baseline Ecology Study. (Iowa Univ., Iowa City (USA). Dept. of Civil (Environmental) Engineering). 15 Jun 1972. 152p. Dep. NTIS.

For Iowa Electric Light and Power Co., Cedar Rapids.

7102 (DOCKET-50333-71) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 20 Nov 1972. 168p. Dep. NTIS.

7103 (DOCKET-50334-47) BEAVER VALLEY POWER STATION, UNIT 1. Environmental Report, Amendment 3. (Duquesne Light Co., Pittsburgh, Pa.). 10 Nov 1972. 26p. Dep. NTIS.

7104 (DOCKET-50334-48) BEAVER VALLEY POWER STATION, UNIT 1. Possible Flooding of Safety Related Equipment. (Duquesne Light Co., Pittsburgh, Pa.). 2 Nov 1972. 2p. Dep. NTIS.

7105 (DOCKET-50348-47) JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 1. Permitted Preheat Temperatures During Production Welding. (Directorate of Regulator Operations (AEC), Atlanta, Ga. (USA. Region II). 17 Nov 1972. 1p. Dep. NTIS.

7106 (DOCKET-50361-32) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Preliminary Safety Analysis Report, Amendment 16, Errata. (Southern California Edison Co., Rosemead, Calif.). 9 Nov 1972. 21p. (DOCKET-50362-31). Dep. NTIS.

Corrected information is presented concerning electrical systems and transmission lines. (D.C.C.)

7107 (DOCKET-50361-34) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Nov 1972. 356p. (DOCKET-50362-33). Dep. NTIS.

The environmental effects of construction and operation of the San Onofre Power Reactor Units 2 and 3 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (D.C.C.)

7108 (DOCKET-50369-30) McGUIRE NUCLEAR STATION, UNITS 1 AND 2. Decision to Use on Unit No. 1 Reactor Vessel in Manufacture With Combustion Engineering Company. (Duke Power Co., Charlotte, N. C.). 24 Oct 1972. 2p. (DOCKET-50370-30). Dep. NTIS.

7109 (DOCKET-50390-30) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Safety Evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 17 Nov 1972. 19p. (DOCKET-50391-30). Dep. NTIS.

7110 (DOCKET-50397-32) HANFORD NO. 2 NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Amendment 15. (Washington Public Power Supply System, Richland). 27 Nov 1972. 161p. Dep. NTIS.

Additional information is presented concerning site geology and seismology. (D.C.C.)

7111 (DOCKET-50398-25) MENDOCINO POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 15. (Pacific Gas and Electric Co., San Francisco, Calif.). 15 Nov 1972. 1159p. (DOCKET-50399-25). Dep. NTIS.

Revised and requested data are presented concerning structures, transmission lines, operating costs, and site geology and biology. (D.C.C.)

7112 (DOCKET-50400-29) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Preliminary Safety Analysis Report, Amendment 18. (Carolina Power and Light Co., Raleigh, N. C.). 17 Nov 1972. 333p. (DOCKET-50401-29; DOCKET-50402-29; DOCKET-50403-29). Dep. NTIS.

Revised and additional data are presented concerning auxiliary systems, layout of structures, and site geology. (D.C.C.)

7113 (DOCKET-50404-28) NORTH ANNA POWER STATION, UNITS 3 AND 4. License Application and Preliminary Safety Analysis Report, Amendment 12. (Virginia Electric and Power Co., Richmond). 15 Nov 1972. 71p. (DOCKET-50405-28). Dep. NTIS.

Revised and requested data are presented concerning containment systems, loss of coolant accident analysis, site, and safety analysis. (D.C.C.)

7114 (DOCKET-50404-29) NORTH ANNA POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Amendment 13. (Virginia Electric and Power Co., Richmond). 1 Dec 1972. 101p. (DOCKET-50405-29). Dep. NTIS.

Revised and requested data are presented concerning the cooling system, quality assurance program, safety analysis, containment system, and site. (D.C.C.)

7115 (DOCKET-50410-14) NINE MILE POINT NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Supplement 3. (Niagara Mohawk Power Corp., Syracuse, N. Y.). Jun 1972. 247p. Dep. NTIS.

Revised and requested data are presented concerning personnel and cooling systems. (D.C.C.)

7116 (DOCKET-50410-15) NINE MILE POINT NUCLEAR STATION, UNIT 2. Environmental Report, Supplement 3. (Niagara Mohawk Power Corp., Syracuse, N. Y.). Dec 1972. 63p. Dep. NTIS.

7117 (DOCKET-50412-2) BEAVER VALLEY POWER STATION, UNIT 2. Notice of Receipt of Application for Construction Permit and Facility License and Availability of Applicants' Environmental Report: Time for Submission of Views on Antitrust Matter. (Directorate of Licensing (AEC), Washington, D. C.). 27 Nov 1972. 14p. Dep. NTIS.

7118 (DOCKET-50413-5) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Application for License, Amendment 1. (Duke Power Co., Charlotte, N. C.). 27 Nov 1972. 5p. (DOCKET-50414-5). Dep. NTIS.

Revised information is presented concerning the estimated plant cost. (D.C.C.)

7119 (DOCKET-50413-7) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Notice of Receipt of Application for Construction Permits and Facility Licenses and Availability of Applicant's Environmental Report; Time for Submission of Views on Antitrust Matter. (Directorate of Licensing (AEC), Washington, D. C.). 1 Dec 1972. 14p. (DOCKET-50414-7). Dep. NTIS.

7120 (DOCKET-50416-11) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Notice of Receipt of Application for Construction Permits and Facility Licenses; Time for Submission of Views on Antitrust Matter. (Directorate of Licensing (AEC), Washington, D. C.). 30 Nov 1972. 3p. (DOCKET-50417-11). Dep. NTIS.

7121 FISSION: THE PRO'S AND CON'S OF NUCLEAR POWER. Hammond, Allen. Science; 178: No. 4057, 147-9 (13 Oct 1972).

Arguments for and against electric power generation by nuclear power plants are presented with respect to economic considerations, safety hazards, resource uses, and environmental effects. The development of LWR's for commercial power plants is reviewed, and difficulties in developing LMFBR's are discussed. (L.C.L.)

7122 ACTION ON REACTOR AND OTHER PROJECTS UNDERGOING REGULATORY REVIEW OR CONSIDERATION. Blakely, J. P. (comp.). Nucl. Safety; 13: No. 6, 507-22(1972).

7123 SAFETY-RELATED OCCURRENCES REPORTED IN JUNE AND JULY 1972. Casto, W. R. (comp.) Nucl. Safety; 13: No. 6, 490-3(1972).

7124 FAST REACTOR SAFETY: PROBLEMS AND SOLUTIONS. Gilby, E. V. (United Kingdom Atomic Energy Establishment Authority, Warrington, Eng.). Trans. Amer. Nucl. Soc.; 15: No. 2, 588-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7125 SAFETY AND SITING OF ESTABLISHED POWER REACTOR TYPES. Tanguy, P. (CEA, Saclay, France). Trans. Amer. Nucl. Soc.; 15: No. 2, 590-1(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7126 REACTOR SAFETY THROUGH QUALITY ASSURANCE AND IN-SERVICE INSPECTION. Bush, S. H. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 591-2(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7127 PRINCIPLES OF REACTOR SITING. Bergstroem, S. O. W. (Aktiebolaget Atomenergi, Nykoeping, Sweden). Trans. Amer. Nucl. Soc.; 15: No. 2, 593(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7128 ROLE OF NEPA ENVIRONMENTAL ASSESSMENT IN NUCLEAR ENGINEERING EDUCATION. Gage, S. J. (Office of Science and Tech., Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 635-6(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7129 WASHINGTON STATE SITE CERTIFICATION FOR HANFORD NO. 2. Haggard, J. E. (Houghton, Cluck, Coughlin and Riley, Seattle). Trans. Amer. Nucl. Soc.; 15: No. 2, 646 (Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7130 ENVIRONMENTAL IMPACT MODELING FOR BREEDER REACTORS. Duffey, Dick (Univ. of Maryland, College Park). Trans. Amer. Nucl. Soc.; 15: No. 2, 646-7(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7131 HOW SAFE IS SAFE ENOUGH: AND WHY? Farmer, F. R. (United Kingdom Atomic Energy Authority, Warrington, Eng.). Trans. Amer. Nucl. Soc.; 15: No. 2, 823(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7132 HOW SAFE IS SAFE ENOUGH: AND WHY? Starr, Chauncey (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 15: No. 2, 823(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7133 PRO BONO PUBLICO. Ley, H. L. Jr. (Food and Drug Administration, Bethesda, Md.). Trans. Amer. Nucl. Soc.; 15: No. 2, 823-4(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7134 HOW SAFE IS SAFE ENOUGH: AND WHY? Lowenstein, Robert (Lowenstein, Newman, and Reis, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 824(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7135 HOW SAFE IS SAFE ENOUGH: AND WHY? Roisman, A. Z. (Attorney for National Intervenors, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 824-5(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7136 HOW SAFE IS SAFE ENOUGH: AND WHY? Simpson, J. W. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 15: No. 2, 825(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7137 HOW SAFE IS SAFE ENOUGH: AND WHY? Lapp, R. E. (Energy/Nuclear Consultant, Alexandria, Va.). Trans. Amer. Nucl. Soc.; 15: No. 2, 825-6(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7138 STOCHASTIC DECISION MAKING APPLIED TO NUCLEAR REACTOR SAFETY. Schleicher, R. W. Jr.; Cady, K. B. (Cornell Univ., Ithaca, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 2, 827(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7139 EFFECTS OF ELECTRICAL SYSTEM UNDERFREQUENCY TRANSIENTS ON PRESSURIZED WATER REACTORS. Kearns, K. D.; Rossi, C. E.; Geets, J. M. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 15: No. 2, 828(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Propulsion and Auxiliary Power Reactors

Refer also to abstracts 5383, 5645, and 5699.

7140 NUCLEAR PROPULSION FOR NAVAL WARSHIPS. HEARING AND SUBSEQUENT INQUIRY OF THE SUBCOMMITTEE ON MILITARY APPLICATIONS OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETY-SECOND CONGRESS, FIRST AND SECOND SESSIONS, MAY 5, 1971–SEPTEMBER 30, 1972. Washington, D. C.: Joint Committee on Atomic Energy (1972). 359p. GPO $2.25.

7141 CONTAINER SHIP MARKET AND NUCLEAR SHIPS. Kinsky, T. (CEA, Paris). Energ. Nucl. (Paris); 14: No. 3, 232-7(1972). (In French).
Most of the studies undertaken on the economic feasibility of nuclear propulsion concern container ships. The characteristics of container ships are examined together with the conditions under which they are used. The general problems associated with the transport of containerized goods and the specific problems posed by nuclear propulsion are examined. (France)

7142 EXPERIMENTAL FLOW STUDIES OF THE COLLOID CORE REACTOR CONCEPT. Turman, B. N.; Hasinger, S. H. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). J. Spacecraft Rockets; 9: No. 10, 723-4(Oct 1972).
New experiments with heavily loaded two-component vortex flows show that the interpretation of particle behavior in terms of a rotating fluidized bed model, previously established for small length/diameter ratios, is valid for length/diameter ratios approaching unity. Experimental data demonstrate that air injection on the end-wall contributes significantly to the net angular velocity of the rotating particle cloud, and the simplifying assumptions made for the tangential force balance are reasonable. The rotating fluidized bed model allows extrapolation of these experiments to the operating regime for a conceptual colloid core reactor. (auth)

7143 THERMIONIC REACTOR PROGRAMS: U. S. AND ABROAD. Price, L. K.; Beard, D. S. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 2, 609(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7144 THERMIONIC REACTOR SYSTEM APPLICATION TO ELECTRIC PROPULSION MISSIONS. Schaupp, R. W. (Advanced Concepts and Missions Div., Moffett Field, Calif.); Mondt, J. F.; Nakashima, A. M. Trans. Amer. Nucl. Soc.; 15: No. 2, 610(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7145 THERMIONIC REACTOR POWER SYSTEMS. Homeyer, W. G.; Allen, D. T.; Gietzen, A. J.; Ingber, J. F.; Owen, M. B. (Gulf General Atomic Co., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 610-11(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7146 NEUTRONIC CHARACTERISTICS OF THERMIONIC REACTORS. Merrill, M. H.; Hackney, M. R.; Marshall, A. C. (Gulf General Atomic Co., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 611(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7147 THERMIONIC FUEL ELEMENT DEVELOPMENT. Gietzen, A. J.; Holland, J. W. (Gulf Energy and Environmental Systems, San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 611-13(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7148 EMERGING NEEDS FOR MOBILE NUCLEAR POWER PLANTS. Anderson, J. L. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 15: No. 2, 615(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7149 HYDROGEN EFFECT ON A DEMONSTRATION TEST FOR OPEN-CYCLE GAS CORE REACTOR. Kunze, J. F.; Lofthouse, J. H.; Shaffer, C. J. (Aerojet Nuclear Corp., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 2, 616-17 (Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7150 SWELLING IN FUELED ZIRCONIUM HYDRIDE. Schwartz, D. M. (California State Univ., Northridge); Brengle, R. G.; Walter, J. H. Trans. Amer. Nucl. Soc.; 15: No. 2, 733-4(Nov 1972).
From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

Research and Test Reactors

Refer also to abstracts 5304, 5336, 5712, and 5716.

7151 (DOCKET-50231-127) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Technical Specifications, Proposed Change 15, Additional Information. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). 29 Nov 1972. 3p. Dep. NTIS.

Requested information is presented concerning the intrusion alarm system. (D.C.C.)

7152 (EUR-4861) PULSED SOURCE EXPERIMENTS WITH HEAVY WATER MODERATED NATURAL URANIUM LATTICES IN EXPO AND ECO. Birkhoff, G.; Bondar, L.; Hage, W.; Ley, J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1972. 38p. Dep. NTIS (U. S. Sales Only). EUR B.Fr. 50.-.

In 1967 several pulsed source experiments were made at Ispra in the subcritical facility EXPO and the zero power critical reactor ECO. The aim of these experiments was to study the problems connected with pulsed source reactivity measurements in natural uranium, heavy water moderated reactors, which are mainly characterized by a long generation time as compared with the short living delayed neutron life time. A survey is presented of various experimental and analytical methods applied along with the results of reactivity and generation time measurements in the negative reactivity range between about 0.17 and 40 $. The results are confronted with two group calculations, and systematic deviations are discussed. For the far subcritical cases a considerable deviation of about 5% of the theoretical reactivity values remains unexplained. (EURATOM)

7153 ISSLEDOVATEL'SKIE YADERNYE REAKTORY. (Nuclear Reactors for Research). Bat, G. A.; Kochenov, A. S.; Kabanov, L. P. Moscow; Atomizdat (1972). 272p.

Research reactors are discussed with regard to their physical features, neutron fluxes available, power levels, heat exchange and hydrodynamic problems, and fuel element construction. One chapter groups nuclear reactors for purposes of further consideration, as follows: High flux, loop, commercial, and reactors with non-steady-state fluxes. Basic types of construction, block diagrams of cooling circuitry and control and protection systems are explored. Trends in the development of new research reactors are examined: powerful neutron sources as competitors with reactors, higher neutron fluxes, novel engineering designs, and some thoughts on the economics of the subject. (K.S.W.)

7154 REPETITIVE PULSE OPERATION OF A NUCLEAR REACTOR, HTR. Inoue, Kiyoshi (Hitachi Ltd., Kawasaki, Japan); Doi, Akira; Inagaki, Kiyokazu; Imai, Munemaro; Nishikawa, Motoyuki. Hitachi Hyoron; 54: No. 5, 395-8(May 1972). (In Japanese).

Repetitive pulse operation of the HTR (Hitachi Training Reactor) is described. Variation of fuel temperature due to pulsed neutron irradiation was measured and compared with a theoretical analysis performed by REACT code. On-line data processing was performed with a small computer, HITAC 10. 1.0% $\Delta k/k$ reactivity was given to the HTR at 1 minute time intervals by the repetitive withdrawal and insertion of a pulsing rod. The maximum instantaneous power output was about 30 MW. The maximum temperature at the center of hottest fuel rod was about 1,350°C. It was concluded that the temporary temperature rise observed at the cladding of the monitored fuel rod was a symptom of fuel burn-out. A comparison of measured and computed data showed that the REACT code designed for the analysis of reactivity accidents satisfactorily predicts transient variations of reactor power and fuel temperature. (Japan)

7155 NEUTRONIC BEHAVIOR OF THE ROVER NUCLEAR FURNACE REACTOR. Plassmann, E. A.; Geer, W. U. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 613-14(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7156 SWELLING BEHAVIOR OF EBR-II MARK-II DRIVER FUEL CLADDING. Flinn, J. E.; Hofman, G. L.; Olson, N. J. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 2, 721(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7157 ANALYSES OF FUEL DATA FOR BURST-TYPE REACTORS. Bump, T. R. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 729-30(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7158 SODIUM VAPOR TRAPS FOR THE FFTF. Guon, J.; Bodine, J. E.; McKisson, R. L. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 2, 743-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D.C. (12 Nov 1972). See CONF-721109.

7159 SURFACE DISTRIBUTION OF ACTIVATED NUCLIDES IN AN EBR-II FUEL CAPSULE. Colburn, R. P. (Westinghouse Advanced Reactors Div., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 2, 745(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7160 PREDICTING THE OPTIMUM CORE CONFIGURATION FOR EBR-II WITH A STAINLESS-STEEL REFLECTOR. Miller, L. B. (Argonne National Lab., Ill.); Gillette, J. L.; Kirn, F. S.; Jarka, R. E. Trans. Amer. Nucl. Soc.; 15: No. 2, 748(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7161 ANALYSIS OF MARK IA RUN-TO-FAILURE EXPERIMENTS IN EBR-II. Olson, N. J.; McClellan, G. C.; Flinn, J. E.; Franklin, D. G.; Miller, S. C. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 2, 748-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7162 ANISOTROPIC SCATTERING CALCULATIONS FOR A STAINLESS-STEEL REFLECTOR. Long, J. K. (Argonne National Lab., Idaho Falls, Idaho); Meneghetti, D. Trans. Amer. Nucl. Soc.; 15: No. 2, 796-7(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7163 SPECTRUM MODIFICATION IN THE ACPR FOR LMFBR FUEL PIN TRANSIENT STUDIES. Lucoff, D. M. (Univ. of New Mexico, Albuquerque); Schmidt, T. R. Trans. Amer. Nucl. Soc.; 15: No. 2, 816-17(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7164 PAJARITO DYNAMICS CODE WITH APPLICATION TO REACTOR EXPERIMENTS. Stratton, W. R.; Peterson, D. M.; Engle, L. B. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 2, 819-20(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7165 ANALYSES OF HYPOTHETICAL INLET FLOW BLOCKAGES IN THE EBR-II RADIAL REFLECTOR. Gopalakrishnan, A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 2, 836-8(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7166 FLOW-MODELING STUDIES FOR A HOMOGENEOUS CORE LOADING IN EBR-II. Gopalakrishnan, A. (Argonne National Lab., Ill.); McGinnis, F. D. Trans. Amer. Nucl. Soc.; 15: No. 2, 863-4(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7167 MARK-II: A SIMULATED FTR FUEL ASSEMBLY SODIUM FLOW TEST FINAL INSPECTION. Myers, R. L.; Borisch, R. R. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 2, 868-9(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7168 FFTF PROBE-TYPE EDDY-CURRENT FLOWMETER WET vs DRY PERFORMANCE EVALUATION IN SODIUM. Costello. T. J.; Laubham, R. L.; Miller, W. R.; Smith, C. R. (Westinghouse Advanced Reactors Div., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 2, 871(Nov 1972).

From American Nuclear Society international meeting; Washington, D. C. (12 Nov 1972). See CONF-721109.

7169 EVALUATION OF EBR-II OPERATIONS WITH HIGH-BURNUP METAL (MARK-II) DRIVER FUEL. Sehgal, B. R. (Argonne National Lab., Ill.); Campise, A. V.; Lo, R. K.; Rempert, R. H. Trans. Amer. Nucl. Soc.; 15: No. 2, 884-5(Nov 1972).

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Reactor Components, Fuels, and Accessories

Refer also to abstracts 5197, 5380, 5581, 5595, 5600, 5607, 5611, 5614, 5626, and 5685.

7200 EFFECT OF RUPTURE IN A PRESSURIZED NOBLE-GAS ADSORPTION BED. Underhill, D. W. (Harvard School of Public Health, Boston). Nucl. Safety; 13: No. 6, 478-81(1972).
Theoretical and experimental studies show that, in the event of an accidental rupture of a pressurized noble-gas adsorption bed, (1) the fractional release of adsorbed fission gases can be smaller than the ratio of the initial-to-final bed pressures; (2) for a given set of conditions, the fraction of krypton released will be greater than that of xenon; and (3) where the leak is relatively slow and the carrier gas is argon, as in the proposed Fast Flux Test Facility design, the fraction of fission gases escaping can be significantly smaller than that of the carrier gas. (auth)

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7206 IMPROVEMENTS IN OR RELATING TO ELECTRIC CIRCUITS. Roe, P. A. (to Associated Electrical Industries Ltd.). British Patent 1,286,301. 23 Aug 1972. Filed 23 Jan 1969.

Reference is made to electric circuits that are responsive to the rate of change of a variable input signal. Such circuits may be used in nuclear reactor control systems to initiate emergency procedures in the event of, for example, reactor temperature rising at an excessive rate. In the circuit described the difference between the value of the variable signal and a predetermined value is amplified by means of a chopper amplifier, and means are provided responsive to the output signal level from the chopper amplifier to supply a chopping signal only so long as the output signal level does not change by more than a predetermined amount in a predetermined time. The output signal from the chopper amplifier is rectified, smoothed and periodically sampled, the sampled value being stored in the form of a voltage level across a storage capacitor, and the smoothed rectified output signal being compared continuously with the sampled value. The predetermined time may be the interval between successive samples. Means may be provided to superimpose a rectangular waveform signal on the storage capacitor voltage, together with means to compare the superimposed signals with the variable voltage input and to produce a rectangular wave output signal in response to the rectangular wave component of the superimposed signals only as long as the voltage excursions of the rectangular wave component give rise to polarity changes in the resultant of the comparison. A demodulator may be provided arranged to produce an output signal only when the rectangular wave signals are present at both inputs thereof. (UK)

Reactor Physics and Core Engineering

Physics

Refer also to abstract 6898.

7207 (EURFNR-1018) NUSYS PHASES 41501-41505, SURFACE-TRUE APPROXIMATION OF STEP FUNCTIONS AND THEIR USE IN NUCLEAR CALCULATIONS (ITERATIVE REMO METHOD). Thiem, D. (comp.) (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Mar 1972. 39p. (KFK-1576). Dep. NTIS.
Work Performed under United States-Euratom Fast Reactor Exchange Program.

The REMO-Method is used in the Karlsruhe Nuclear Code System NUSYS for the correction of the effective elastic removal multigroup constants, which are normally determined by the well-known σ_0-concept. A suitable many-group (e.g., 208 groups) collision density is needed as weighting function to generate the improved elastic removal group constants. The multigroup (e.g., 26 groups) collision density obtained when applying the improved group constants can be used for a further iterative improvement of the multigroup elastic removal constants and the corresponding neutron spectrum. To provide a new weighting function one has to modify the multigroup collision density in an appropriate manner to obtain a function with a many group structure. This is performed by smoothing the multigroup collision density and rearranging the result into the many group scheme. Several NUSYS-Codes developed for this purpose are described and an instruction to the user for the application of the iterative REMO-Method is given. 10 references. (auth)

7208 CALCULATION OF THE ENERGY SPECTRA OF NEUTRONS EMITTED BY A SUBCRITICAL MASS USING THE TIME OF FLIGHT. Rotival, M. (CEN de Cadarache, Paul-lez-Durance, France). Nucl. Instrum. Methods; 105: No. 1, 163-7(1972). (In French).
In time-of-flight experiments, principally in the measurement of subcritical assembly spectra, the neutrons have a variable emission time, and this destroys the simple relation between arrival time and energy. A resolution correction is proposed to take account of the "non-separability" of energy and emission time. (6 figures) (auth)

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Core Thermal Hydraulics

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GENERAL

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7237 (ORNL-EIS-72-9) ENVIRONMENTAL LAW ABSTRACTS. VOLUME II. Curlin, J. W.; Jones, J. D. (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 205p. Dep. NTIS.

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7238 FEW CONSIDERATIONS ABOUT THE PHILOSOPHY OF LEGAL DISPOSITIONS IN THE FIELD OF THE NUCLEAR ACTIVITIES. Hubert, E. H. (Univ., Liege). RUM, Rev. Universelle Mines; 115: No. 1, 3-12(1972). (In French).

7239 PROTECTION AGAINST IONIZING RADIATIONS. A SURVEY OF CURRENT WORLD LEGISLATION. Geneva; World Health Organization (1972). 329p. $7.00.

Current world radiation protection legislation is surveyed. The survey includes medical uses of radiations, nonmedical uses, nuclear reactors and other nuclear installations, technical qualifications of users, health protection of workers, over-exposures and other events, transport of radioactive materials, food irradiation, consumer goods and domestic exposures, shoe-fitting fluoroscopes, disposal of radioactive wastes, environmental monitoring, and protection of public in the event of radiation accidents. Legislation from the following countries is included in the survey: Australia; Austria; Belgium; Bulgaria; Canada; Denmark; Federal Republic of Germany; Finland; France; Italy; Netherlands; New Zealand; South Africa; Spain; Sweden; Switzerland; Union of Soviet Socialist Republics; United Kingdom; and USA. (E.R.B.)

Management

7240 (NP-19469) SIXTEENTH ANNUAL REPORT, 1971/72. (Atomenergikommissionen, Copenhagen (Denmark)). Oct 1972. 64p. Dep. NTIS (U. S. Sales Only).

Topics include events of the year, participation in international collaboration, and activities at Risoe (reactor technology, irradiation technology, agricultural research, basic research, and research facilities and auxiliary services). Also, members of the Danish AEC, committees, etc.; the staff of the Danish AEC; an extract from the accounts; a selected list of staff publications; a guide to the Danish AEC and the Research Establishment Risoe; and research facilities at the Research Establishment Risoe are presented in the appendices. (W.H.K.)

7241 ASSESSMENT OF APTITUDE FOR WORK INVOLVING THE RISK OF EXPOSURE TO IONISING RADIATION. EXPERIENCE COVERING 7835 APPLICANTS. Giubileo, M.; Strambi, E. Med. Lavoro; 62: No. 1, 1-13(Jan 1971). (In Italian).

Results of aptitude tests carried out on 2489 persons (out of 7835 applicants) at two nuclear research centers in Italy are presented. 2186 were found fit for work involving possible exposure to radiation, 120 were found fit subject to certain reservations, 134 were temporarily unfit, and 49 definitely unfit. The authors explain in detail the grounds on which they based their assessments and examine whether certain criteria used to determine aptitude for radiation work are not too theoretical, and whether they should not be revised in the light of fresh studies in the field of radiation biology. (Occup. Safety and Health Abstr.)

Mathematics and Computers

Refer also to abstract 6446.

Miscellaneous

7242 (ACRH-1000-381) REPORT ON WORKSHOP SESSION. CLINICAL EVALUATION, STAGING, AND PROGNOSIS. Carbone, P. P.; Castellino, R.; Hoffer, P.; Jelliffe, A. M.; Kaplan, H. S.; Rosenberg, S. A.; Tubiana, M.; Ultmann, J. E. (Argonne Cancer Research Hospital, Chicago, Ill.). 1972. 4p. (CONF-720338-2). Dep. NTIS.

From International symposium on Hodgkin's disease: 1972; Stanford, CA. (20 Mar 1972).

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7244 (ARH-SA-97) REACTION OF HYDROXYLAMINE WITH NITROUS ACID. Barney, G. S. (Atlantic Richfield Hanford Co., Richland, Wash.). Jun 1971. Contract AT(45-1)-2130. 16p. (CONF-710658-1). Dep. NTIS.

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7245 (BDX-613-259) EDITOR'S NOTEBOOK. Walker, Floyd A. (Bendix Corp., Kansas City, Mo.). Sep 1972. Contract AT(29-1)-613. 22p. Dep. NTIS.

7246 (BDX-613-544) ELECTRICAL TERMINATIONS: WELDED, BRAZED, AND BONDED, FY72-1. Stittsworth, D. E. (Bendix Corp., Kansas City, Mo.). Jul 1972. Contract AT(29-1)-613. 59p. Dep. NTIS.

7247 (BDX-613-687) CABLE FABRICATION AND ENCAPSULATION PROCESS IMPROVEMENTS FY72-3. Quarterly Report. Husby, T. J. (Bendix Corp., Kansas City, Mo.). Sep 1972. Contract AT(29-1)-613. 38p. Dep. NTIS.

7248 (BDX-613-738) NONMETALLIC TOOLING CAPABILITIES AND ECONOMICS, FY72-4. Quarterly Report. Freund, R. W. (Bendix Corp., Kansas City, Mo.). Oct 1972. Contract AT(29-1)-613. 14p. Dep. NTIS.

7249 (BDX-613-740) CABLE FABRICATION AND ENCAPSULATION PROCESS IMPROVEMENTS FY72-4. Quarterly Report. Husby, T. J. (Bendix Corp., Kansas City, Mo.). Oct 1972. Contract AT(29-1)-613. 32p. Dep. NTIS.

7250 (BDX-613-742) FLUID FLOW ANALYSIS IN THE MOLD HEATING AND COOLING CONTROL LOOP. Interim Report. Floersch, R. H. (Bendix Corp., Kansas City, Mo.). Sep 1972. Contract AT(29-1)-613. 101p. Dep. NTIS.

7251 (CEA-CONF-2029) AUTOMATIC TREATMENT OF ELECTRONSTAGMOGRAPHIC DATA. Max, J.; Despringre, A. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 21 Dec 1972. 19p. (In French). (CONF-720123-1). Dep. NTIS (U. S. Sales Only).

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Thesis.

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7315 (UCRL-Trans-1483) RACHITIC SYNDROME OF VON JAKSCH-LUZET: PHYSIOPATHOLOGICAL CONSIDERATIONS. Jean, R.; Bonnet, H.; Navarro, M.; Emberger, J. M.; Rieu, D.; Vigo, F.; Branier, J.; Karlin, R. Translated by H. G. Parker (Univ. of California, Lawrence Berkeley Lab., Berkeley, from Gaz. Med. France; 77: 7083-8(1970). 11p. Dep. NTIS.

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7317 ADMINISTRATIVE AND ACCOUNTING ORGANIZATION OF THE COMISION NACIONAL DE ENERGIA NUCLEAR. Gama, J. M. G. Mexico City; Universidad Nacional Autonoma de Mexico (1969). 185p. (In Spanish).
Thesis.

The historic precedents in the organization of national and international bodies dealing with nuclear energy are briefly reviewed. The administrative and accounting organization of the Mexican Nuclear Energy Commission is outlined and annotated. (J.S.R.)

7318 RECORDER (31 Mar 1971) (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-2212).
1 drawing.

7319 IMPROVED FLOW CELL FOR MODEL MPS-2 MULTIPARAMETER CELL SORTER (Aug 1972) (Engineering Materials). (Los Alamos Scientific Lab., NM). (CAPE-2262).
8 drawings.

The Model MPS-2 multiparameter cell sorter is an improved device similar in basic principles and used for the same purposes as the unit described as a multiparameter cell separator by LASL in February 1972 (see CAPE-2201) at the annual meeting of the Biophysical Society in Toronto, Canada. An improved flow cell having the advantage of simplified design and construction, orifice interchangeability and prealignment, and ease of operation is utilized. The Model MPS-2 sorter is a high-speed laminar flow system designed for multisensor cell analysis and sorting when used with the necessary electronic and optical equipment. Multisensor cell analysis can be made on the basis of Coulter volume sensing, small-angle light scatter, and fluorescence of Feulgen stained cells. Sorting may be done on the basis of one or more of

these parameters. In operation, the stained cells are introduced on the axis of a moving sheath fluid which confines them centrally as they pass through a Coulter volume sensing orifice. Cells next pass through a "viewing" region intersecting a focused argon laser beam with resultant fluorescence and light scatter. A second laminar sheath is introduced in this region and the whole stream jetted into the atmosphere as a solid stream through a hydrodynamically aligned orifice. The electro-optical signals can be electronically processed for optimum cell discrimination at rates up to 5×10^3/sec. The signals can also be used to trigger sorting using the technique described by M. J. Fulwyler [Science 150, 910 (1965)] at rates up to 10^3 sorted cells/sec. (auth)

7320 X-RAY PREMONOCHROMATOR (Aug 1968) (Engineering Materials). (Nebraska Univ., Lincoln). (CAPE–2213).
12 drawings.

7321 PAPER TAPE TO TYPEWRITER TRANSLATOR TO SUPPRESS ZEROS (Mar 1972) (Engineering Materials). (Oak Ridge National Lab., TN). (CAPE–2250).
3 drawings.

7322 ^{3}He CALORIMETER (Nov 1970) (Engineering Materials). (Ames Lab., IA). (CAPE–2253).
28 drawings.

7323 CALORIMETER (Nov 1971) (Engineering Materials). (Ames Lab., IA). (CAPE–2243).
5 drawings.

7324 SIM-11 SIMULATOR (11 May 1972) (Engineering Materials). (Los Alamos Scientific Lab., NM). (CAPE–2229).
6 drawings.

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6 drawings.

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